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ARITHMETICK IN EPITOME.

In Two Parts.

By *WILLIAM WEBSTER*, W. M.

The Second Edition.

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ARITHMETICK
in
Epitome:
or, a
Compendium
of all its Rules,
both
Vulgar & Decimal.

IN TWO PARTS.

Intended for the Remembrance, and further Improvement, of Those who have already made some Progress in this usefull Science.

The Second Edition.

By WILLIAM WEBSTER,
Writing Master & Accomptant,
At the Corner of Cecil Court, on the Pavement in St. Martins Lane.

Where Youth may Board.

Grip.t *Bickham sculp.t*

ARITHMETICK

Practick:

To the Right Honourable

Robert Walpole, *Esq*;

First Commissioner of the Treasury, and Chancellor of the Exchequer, &c.

SIR,

THO' the Distrust, so natural to a young Author on his first Performance, did indeed discourage me from complying with my Inclination, in offering this Attempt to your HONOUR on its first Publication; yet somewhat encourag'd by the favourable Reception its first Edition hath met with, I now humbly presume to lay this second

Impreſſion at your Feet; knowing the Advantage it will appear with under the Patronage of a Name ſo eminent for the Encouragement of *Clerkſhip*, and famous for every Thing Great and Honourable.

IT's Imperfections, I am very ſenſible, will be but too apparent to your HONOUR's Judgment; but that Goodneſs, of which I have already had ſo abundant Experience, gives me Hopes your HONOUR will excuſe both them, and this Preſumption, of

Your HONOUR's

Moſt Obedient,

AND

Moſt Humble Servant,

William Webſter.

THE PREFACE.

NOT *to detain the Reader with many Words to little Purpose, I shall only here observe, that my cheif Regard in this Attempt, has been to serve the ingenious* Clerks *and* Accomptants *of the several Offices of* Great Britain, *and such other Gentlemen whose Business re-*

quires the Practice of Arithmetick, *with an uſeful Pocket Volume.*

I know ſomething of this Nature has been much wanted; and therefore hope what is here offer'd, will not be altogether unacceptable.

'Tis a common Complaint, that Books of Arithmetick are very bulky; and indeed not a few are diſcourag'd, by their Length, from their Peruſal; but as the many Treatiſes already printed on this Subject, ſeem chiefly intended for the Inſtruction of the utterly ignorant, (tho' of ſuch, ſcarce one in an hundred is capable of apprehending them) ſo it is impoſſible but they muſt be tediouſly long; whereas, if Gentlemen are but well acquainted with its firſt five Rules, (viz. Numeration, Addition, Subſtraction,

ſtraction, Multiplication, *and* Diviſion) *half the Words commonly us'd, will carry them thro' the whole Study, and make them compleat Maſters of the Science; as I hope this* Compendium *will in ſome Meaſure demonſtrate.*

Such Gentlemen *as are already Proficients, will, I preſume, at leaſt find it an uſeful* Memorandum; *whilſt thoſe who have yet but ſmall Knowledge in Numbers, may, I hope, make an eaſy Improvement by its plain, yet ſhort Inſtructions.*

As I have made Brevity my Aim throughout the whole, ſo I have been more particularly ſhort in the firſt Chapter, of which I ſuppoſe my Reader Maſter; but all vain Repetitions and uſeleſs Tautologies, I have

have all along moſt carefully avoided.

The Method I have us'd, is the neareſt that which is uſually taught in Schools, the Rules being rang'd as they are generally there learn'd; and though I am ſenſible Practice *is not thoroughly to be underſtood, without ſome Knowledge of* Vulgar Fractions, *yet I have choſe to place them in the laſt Chapter of* Vulgar Arithmetick, *becauſe moſt common Buſineſs may be done by Whole Numbers. However,* Vulgar Fractions *being a diſtinct Chapter, the Reader may look into them whenever he thinks it moſt proper.*

All that I ſhall farther urge in its Recommendation, is, that no Care has been wanting in its Correction,

rection, nor Charge ſpar'd to render it compleat. The grand Objection againſt the Uſe of Tables, *from their Uncertainty, (almoſt unavoidable in the Letter-Preſs) is here entirely remov'd, they being all exactly engrav'd from my own correct Originals; and to make them more particularly applicable to the late* Lotteries, *and other Buſineſs of the* Exchequer, *their Calculation is carry'd on to* 32 *Years. The ſmall* Errata *of the other Parts, will, I hope, be excus'd, and the whole Performance kindly accepted by the candid Reader.*

ON

ON

ARITHMETICK.

WOnd'rous Arithmetick! *myſterious Art!*
What Numbers *can thy Uſefulneſs impart?*
What mighty Genius *did thee firſt invent?*
Who to the World firſt ſhew'd thy vaſt Extent?
Sure all the Muſes *did their Labours join,*
And each a Figure form'd, ſo made up NINE;
Which having done, they, as an Emblem, *plac'd,*
To ſhew their boundleſs Uſe, *an endleſs Space;*
A Cypher *call'd, expreſſive Circle! which,*
Tho' in it ſelf is nothing, yet does teach,
As by Hieroglyphick, that in thoſe Nine
All that is uſeful in that Art *combine.*

1 2 3 4 5 6 7 8 9 0

ERRATA.

PART I.

Page	Line	For	Read
4	9	10 oz.	11 oz.
29	14	96 C.	96 lb.
42	In the second Example, remove the Line 5276 one Place towards the Left.		
50	14	3 s.	12 s.
56	15	1 lb.	1 lb. $\frac{1}{4}$
67	18	14 l. 1 s. 10 d.	14 l. 5 s. 10 d.
71	10	2421	1421
ibid.	last	98	198
87	6	08	80
94	last	13	10
103	2	57000	5700
110	Between the Line and 66 rem. of the other Stating, insert 144.		
111	5	Exch. at 53 d.	Exch. at 53 d. $\frac{1}{2}$
119	14	486 l.	846 l.
128	23	5X5X4=14	5+5+4=14
130	19	3	328050
139	21	so many Numbers	so many new Numerators.

PART II.

Page	Line	For	Read
16	10	,765	,7691
21	7	6 d.	9 d.
33	In the Example between 1,04 and 500, insert 1,16985856.		
39	8	41,13152	41,13512
52	20	$\frac{12}{875}$	$\frac{16}{875}$
58	7	5257	2457

VULGAR ARITHMETICK

IN

Whole Numbers and Fractions.

PART I.

THIS inconſiſtent with the intended Brevity of this Treatiſe, to enter upon a nice Enquiry after the firſt Inventors of this uſeful Science, or by what Degrees it has been rais'd to its preſent Perfection. I ſhall therefore only give this general Definition of it, (*viz.* That it is THE ART OF TRUE RECKONING) and proceed to a particular Explanation of its ſeveral Parts.

CHAP. I.

Of the five first, and fundamental Rules.

THE first of which is

NUMERATION, or NOTATION;

by which we learn the different Value of Figures, by their different Places; and, of Consequence, to read or write any Sum, or Number.

The Table.

9	Unites.	1
90	Tens.	12
900	Hundreds.	123
9000	Thousands.	1234
90000	X Thousands.	12345
900000	C Thousands.	123456
9000000	Millions.	1234567
90000000	X Millions.	12345678
900000000	C Millions.	123456789

As I suppose my Reader skill'd in more Rules than this, I shall, without further Explanation, go on to the second, viz.

ADDITION

ADDITION;

BY which we find the Whole, or Total, of two or more Parts, or Sums.

For your greater Ease in casting up of Money, learn the following

Pence-Table.

Pence.		s.	d.	Pence.		s.	d.
20		1	8	80		6	8
30		2	6	90		7	6
40	is	3	4	100	is	8	4
50		4	2	110		9	2
60		5	0	120		10	0
70		5	10				

Examples in Whole Numbers and Money.

l.	*Yards.*	*l.*	*s.*	*d.*	
756	1325	735	18	09 $\frac{1}{4}$	
282	4532	423	10	10 $\frac{1}{2}$	
458	7345	784	12	05 $\frac{3}{4}$	
736	1298	297	08	04	
857	8473	542	11	11 $\frac{1}{2}$	
241	5249	298	14	07 $\frac{1}{4}$	
3180	28222	3082	17	00 $\frac{3}{4}$	Total.

Examples in Avoirdupoise *and* Troy-Weights.

Avoirdupoise.

Tuns.	*C.*	*q.*	lb.	*oz.*	*drams.*	
753	19	3	27	15	15	
347	08	1	17	10	06	
283	11	0	12	03	10	
549	05	2	13	09	07	
251	13	0	15	03	11	
2185	18	1	02	15	01	Total.

Troy-Weight.

lb	*oz.*	*dwts.*	*grs.*	
327	11	19	23	
429	10	17	19	
274	08	13	09	
478	10	12	05	
326	09	18	11	
1838	04	01	19	Total
1510	04	01	20	Tot. without the top-line.
1838	04	01	19	Proof.

To know how many Drams make an Ounce, or Grains a Penny-weight, *&c.* (if your Memory fails) see the Tables, Page 15.

Proof of Addition.

The Proof of this Rule is usually by a second Addition, without the Top-line; which second Total, if when

when added to the uppermoſt Line, it makes the firſt Total, the Work is ſuppos'd right. See the laſt Example.

But it is as good, if not a better Proof, to produce the ſame Total, by adding your Sum both up and down. The next Rule is

SUBSTRACTION,

WHICH teaches us, by taking a leſſer Number from a greater, to find the Remainder.

Examples in Integers and Money.

	Yards.
	7146325
	1483972
Rem.	5662353
Proof.	7146325

	l.	*s.*	*d.*
Lent	812	13	08 ¼
Paid	190	19	10 ½
Rem.	621	13	09 ¾
Proof	812	13	08 ¼

	l.	*s.*	*d.*
Borrow'd	429	11	08 ½
at ſeveral	212	17	10
Times.	356	17	05 ¾
Borrow'd in all	999	07	00 ¼
Paid	519	18	09 ¾
Rem.	479	08	02 ½

Avoirdupoise.

Tuns.	*C.*	*qrs.*	*lb*	*oz.*	*drams.*
92	10	0	07	03	13
14	13	3	11	12	05
77	16	0	23	07	08

Troy-Weight.

lb	*oz.*	*dwts*	*grs*	
672	10	05	09	
139	11	05	21	
532	10	19	12	Remainder.
672	10	05	09	Proof.

Sums in this Rule are eaſily prov'd, by adding their Remainders to their leſſer Numbers; which (if right) will make the greater. See the laſt Example.

MULTIPLICATION

IS the fourth Rule, and ſerves inſtead of many Additions; but cannot be well done, without the perfect Knowledge of the following Table.

The TABLE.

3 times	3	9
	4	12
	5	15
	6	18
	7	21
	8	24
	9	27
4 times	4	16
	5	20
	6	24
	7	28
	8	32
	9	36
5 times	5	25
	6	30
	7	35
	8	40
	9	45
6 times	6	36
	7	42
	8	48
	9	54
7 times	7	49
	8	56
	9	63
8 times	8	64
	9	72
9 times	9	81
12 times	2	24
	3	36
	4	48
	5	60
	6	72
	7	84
	8	96
	9	108
	10	120
	11	132
	12	144

In this Rule are three Things to be obſerv'd; the Multiplicand, the Multiplier, and the Product.

The Example ſhews to which Line each Name belongs.

Example.

Example.

75632541 38 Multiplicand.
23456789 Multiplier.

68069287242
60506233104
52942778966
45379524828
37816270690
30253016552
22689762414
15126508276

1774096564684442882 Product.

1
8 + 8 Proof.
1

Proof.

To prove these Sums, cast out the Nines from the Multiplicand and Multiplier, and place the Remainders on the right and left Sides of a Cross, thus made. + These two Figures, multiply'd together, must have the Nines cast out of their Product, and the Remainder plac'd at Top: Then casting the Nines also out of the Product of your Multiplication, place the Remainder at the Bottom; which, if it agrees with the Figure at Top, the Work is right. See the Example.

Or more certain,

A Multiplication Sum is then right, when the Product, divided by the Multiplier, quotes the Multiplicand.

What follows, are some useful

Abreviations.

(1*st*.) When either your Multiplicand, or Multiplier, or both, have one or more Cyphers to the right Hand, only multiply by the Figures, and set on the right Hand of the Product so many Cyphers as were in both the Multiplicand and Multiplier.

Examples.

527000	7583
4000	7000
2108000000	53081000

(2*dly.*) Therefore any Number may be multiply'd by 10, 100, 1000, &c. only by placing on the right Hand of it, one, two, three, or more Cyphers: Thus,

7295

Multiply'd by 10, is 72950; by 100 — 729500, &c.

(3*dly.*) To multiply any Number by 5, add a Cypher to it, and half it. Or by 15, the same; and add both the Lines together.

Examples.

5334 multiply'd

by 5 —	53340	by 15 —	53340
			26670
is —	26670		
		is —	80010

(4*thly.*) Any Number may be multiply'd by 11, 111, or 112, &c. as in the following

Examples.

7136 multiply'd by 11.

7136
7136
78496

By 111, thus: 7136

7136
7136
792096

And

And by 112, thus: 7136
7136
7136
7136
799232

Or thus: 7136
112
85632
7136
799232

We now proceed to our fifth Rule; or,

DIVISION.

BY which we find how often one Number is contain'd in another.

Here alſo you muſt take Notice of four Things, viz. the Diviſor, the Dividend, the Quotient, and the Remainder, as in the

Example.

Diviſor. Dividend. Quotient.
3456789) 567895436783 (164284,
22221653
14809196
9820407
29068298
14139863
312707 Remainder.

There are many Methods of working this Rule. The following Example is divided ſix ſeveral Ways.

(1.)

10(2
1008(1
42645(1332
32222
866

(2.)

10(2
1008(1
32(42645(1332
32684
996

(3.)

10(2
1008(1
32)42645(1332

(4.)

21
·8
10
10
32) 42645(1332
32
96
96
64

(5.)

32) 42645(1332
32
106
96
104
96
·85
64
21

(6.)

32) 42645(1332
106
104
·85
21

Note. The two laſt, call'd the *Italian* Ways, are moſt generally us'd.

Mr. *Alingham* has indeed ſet down nine Ways; but his three others, are ſo very like the 1ſt, 2d, and 3d, of theſe, that they can ſcarce be call'd different.

Abre-

Abreviations.

(1*ſt*.) If there are any Cyphers on the right Hand of your Diviſor, you may cut off ſo many Cyphers or Figures, on the right Hand of your Dividend; remember to bring them down (if Figures) to the Remainder.

Example.

21|00) 8645|29 (411
84

24
21

35
21

1429

(2d.) When your Diviſor is 12, or conſiſts only of one ſingle Figure, or can be reduc'd to one, by cutting off Cyphers from its right Hand, the Work may eaſily perform'd in one Line, thus.

Rule.

Drawing a Line under the Dividend, ſet down under its firſt Figure, how often the Diviſor is contain'd in it; what remains, imagine plac'd before the next Figure; and conſidering how often your Diviſor is contain'd in the Sum it makes, ſet down the Number underneath, as before; and ſo proceeding through all the Figures, ſet down what remains at laſt, in the Place where your Quotient us'd to ſtand. See the

Examples

Examples.

4)93645(1	12)83675(11	7|00)5635|25(
23411	6972	805

(3d.) By the two foregoing Rules, you may observe, that to divide by 10, 100, 1000, &c. is only to cut so many Figures from the right Hand of the Dividend, as there are Cyphers in the Divisor.

Example.

1'000)43682\|735(

So the Quotient is 43682, the Remainder 735.

If you are to divide several Numbers by one common Divisor, (as in the calculating of Tables, &c.) that you may know exactly at once how often your Divisor will go, in some convenient Corner, make a Table of your Divisor, by multiplying it severally by all the nine Digits: Thus, suppose 562 your Divisor,

562	1
1124	2
1686	3
2248	4
2810	5
3372	6
3934	7
4496	8
5058	9

Proofs of Division.

(1st.) Multiplication and Division mutually prove each other: For as if you divide the true Product of a Multiplication by the Multiplier, the Quotient will be

the Multiplicand; ſo, if you multiply the Quotient of a Diviſion by the Diviſor, (taking in the Remainder) the Product will be the Dividend.

(2d.) Another Proof of Diviſion, is by adding together thoſe Lines in the following Example, marked with Aſteriſms, (being the particular Products of the Diviſor, multiply'd ſeverally by each Figure in the Quotient) the Total of which (if right) will be the Dividend.

(3d.) Diviſion may alſo be prov'd as Multiplication, by a Croſs, thus: Caſting out the Nines from the Diviſor and Quotient, place the Remainders on its right and left Sides; then multiplying the two Figures ſo plac'd together, and caſting the Nines from the Product, add what's left to the Remainder of the Diviſion; and ſtill caſting out the Nines, let the Overplus be plac'd at Top; then alſo caſting the Nines from the Dividend, ſet down the Figure remaining at the Bottom; which, if it agrees with that at Top, the Work may be ſuppos'd right. See each Proof in the

Example.

	736)863256(	1172
	736*	736
	1272	7032
3 / 7+2	736*	3516
3		8204
3d Proof.	5365	
	5152*	862592
		664 Remainder.
	2136	
	1472*	863256 1ſt Proof.
	664*	
	863256 2d Proof.	

Before we proceed to *Reduction*, it will be proper to inſert TABLE

TABLES *of* Engliſh *Coins, Weights, and Meaſures.*

Firſt of COINS.

ACCOMPTS are kept in Pounds, Shillings, Pence, and Farthings, thus divided.

4 Farthings, 12 Pence, 20 Shillings } make { 1 Penny, 1 Shilling, 1 Pound, } thus mark'd { *d.* *s.* *l.*

But the uſual Coins are,

		l.	*s.*	*d.*
Of Gold,	A Jacobus,	1	5	6
	A Carolus,	1	3	6
	A Guinea,	1	1	6
	A ½ Guinea,	0	10	9

Of Silver, A Crown, A ½ Crown, } Value; { 0 5 0, 0 2 6
The Names of the reſt ſpeak their Value, as, a Shilling, a Six-pence, a Groat, or 4*d.* a Three-pence, a Two-pence, a Penny.

Of Copper, A ½ Penny, A Farthing, } thus writ, { 0 0 0 ½, 0 0 0 ¼

Weights.

Troy.

24 Grains 20 Pennywts. 12 Ounces	make	1 Pennywt. 1 Ounce, 1 Pound,	thus mark'd,	dwt. oz. lb.

Apothecaries.

20 Grains 3 Scruples 8 Drams 12 Ounces	make	1 Scruple, 1 Dram, 1 Ounce, 1 Pound,	thus mark'd	℈ ʒ ℥ lb

Avoirdupoise.

16 Drams 16 Ounces 28 Pounds 4 Quarters 20 Hundred	make	1 Ounce, 1 Pound, 1 quarter of a Hundred, 1 Hundred, 1 Tun,	thus mark'd	oz. lb qrs. C. Tun

Wool-Weight.

7 Pounds 2 Cloves 2 Stones 6 Todds and ½ 2 Weys 12 Sacks	make	1 Clove, 1 Stone, 1 Todd, 1 Wey, 1 Sack, 1 Last,	mark'd as written

Lead.

C.

19 ½ makes a Fodder.

Measures.

Wine.

2 Pints	make	1 Quart,	thus mark'd,	*qrt.*
4 Quarts,		1 Gallon,		*gall.*
63 Gallons		1 Hogshead,		*hhds.*
2 Hogsheads		1 Pipe,		*Pipe.*
2 Pipes		1 Tun,		*Tun.*

Beer and Ale.

2 Pints	make	1 Quart,	thus mark'd,	*qrt.*
4 Quarts		1 Gallon,		*gall.*
9 Gallons		1 Firkin,		*Firk.*
2 Firkins		1 Kilderkin,		*Kild.*
2 Kilderkins		1 Barrel,		*Bar.*
3 Barrels		1 Butt,		*Butt.*

Note, 8 Gallons make 1 Firkin of Ale.

Dry.

8 Pints	make	1 Gallon,	thus mark'd,	*Gall.*
2 Gallons		1 Peck,		*Peck.*
4 Pecks		1 Bushel,		*Bush.*
4 Bushels		1 Coom,		*Coom.*
2 Cooms		1 Quarter,		*Qr.*
5 Quarters		1 Wey,		*Wey.*
2 Weys		1 Last,		*Last.*

Long.

3 Barley-Corns	make	1 Inch,	mark'd as writ.	* 1760 Yards make a Mile.
12 Inches		1 Foot,		
3 Feet		1 Yard *		
5 Yards and ½		1 Pole or Perch,		
40 Poles		1 Furlong,		
8 Furlongs		1 Mile,		

Land.

40 Square Perches	make	1 Rood.
4 Roods		1 Acre.

Note, That a Geometrical Pace is 5 Feet, and that there are 1056 such Paces in an *English* Mile.

Cloth.

4 Nails	make	1 Quarter,	mark'd,	*qr.*
4 Quarters		1 Yard,		*yd.*

Note, An Ell *Flemish* is 3 *qrs.* An Ell *English* is 5 *qrs.*

12	make	1 Dozen.
12 Dozen		1 Small Gross.
12 Small		1 Great Gross.

CHAP.

CHAP. II.

Of REDUCTION,

WHICH is but an Application of the two preceding Rules. There are three Sorts, *viz.*

First, Reducing great Names into ſmall, which is done by Multiplication.

Secondly, Small Names into great, which is done by Diviſion.

Thirdly, Changing one Sort of Money into another, which is done by reducing both into one Denomination, dividing the one by the other.

Examples of each Sort.

(*1ſt Sort.*)

	l.	*s.*	*d.*	
In	4295	12	3	how many Farthings?
'tis multiply'd by 20				becauſe 20 *s.* make 1 *l.* *Note*, The 12 *s.* are taken in.
	85912			
'tis multiply'd by 12				becauſe 12 *d.* make 1 *s.* And here the 3 *d.* are added.
	1030947			
'tis multiply'd by 4				becauſe 4 Farth. make 1 Penny.
Anſwer,	4123788			Farthings.

(*2d. Sort.*)

(2d. Sort.)

In 4123788 Farthings, how many Pounds?

4)4123788(

12)1030947(3

20)85912(

4295 *l.* 12 *s.* 3 *d. facit*

We divide here by 4, 12, and 20, for the same Reasons that we multiply'd by them in the other Example.

(3d. Sort.)

Change 45967 *French* Crowns, at 4 *s.* 6 *d.* each, into Guineas.

s.	*d.*
21	6
2	
43	

Six-pences in a Guinea

4 *s.* 6 *d.*

2

9

45967

9 Six-pences in a *French* Crown

43)413703(9621 Guineas.

387

267

258

90

86

43

43

0

More Examples.

In 85647 Guineas, how many Pounds Sterling?
Answer, 92070 *l.* 10 *s.* 6 *d.*

In 59463 Marks, at 13 *s.* 4 *d.* how many Pounds?
Answer, 39642 *l.*

How many Dollars, at 4 *s.* 4 *d.* are there in 89573 Pistoles, at 17 *s.* 6 *d.*?
Answer, 361737 Dollars, and 6 *d.* Rem.

In 82 lb. 9 *oz.* 10 *dwts.* 5 *grs.* how many Grains?
Answer, 476885 Grains.

In 56 *Tuns*, 13 C. 2 *grs.* 21 lb. 7 *oz.* 11 *Drams*, how many Drams?
Answer, 32505211 Drams.

How many Minutes since the Birth of our Saviour, it being 1715 Years?
Answer, 901404000 Minutes.

How many Gallons are there in 7569 Tuns?
Answer, 1907388 Gallons.

Note, These Questions revers'd, will make as many more good Examples.

CHAP.

CHAP. III.

Of the RULE *of* THREE.

WHICH is ſo call'd, becauſe by Three Numbers given, we find a Fourth, or Number ſought.

The chief Difficulty of this RULE, lies in ſtating its Queſtions: For your Direction therefore obſerve that of the three given Numbers, two always contain a Suppoſition, and the third a Demand.

The Number then on which the Demand lies, muſt always be the third in your ſtating; of the other two you will be ſure to find one of the ſame Quality with the ſaid third; which being made your firſt, the Number left, muſt, of Conſequence, fall in the ſecond Place, which will bear the ſame Relation to the third (or Number ſought) as the firſt does to the third.

The Queſtion being thus ſtated, you muſt (if they are not already ſo) bring your firſt and third Numbers into one Name, and your ſecond into its loweſt Terms; then multiplying your ſecond and third Numbers together, and dividing the Product by your firſt, the Quotient will be the Anſwer of your Queſtion, of the ſame Name you left your ſecond Number in. See the Examples.

Exampl

Examples.

What must I give for 122 Ells of Holland, if I pay after the Rate of 34 *l.* for 138 Ells?

Ells	*l.*	Ells.
If 138 cost	34	what will 122

34

488
366

138)4148(30 *l.* 1 *s.* 1¼
414

8
20

138)160(1
138

22
12

138)264(1
138

126
4

138)504(3
414

90

The Remainder 8, being Parts of a Pound, are multiply'd by 20, to see what Shillings they will produce; and so the other Remainders, by 12, and 4, to bring out the odd Pence and Farthings.

How

CHAP. III.

Of the RULE *of* THREE.

WHICH is ſo call'd, becauſe by Three Numbers given, we find a Fourth, or Number ſought.

The chief Difficulty of this RULE, lies in ſtating its Queſtions: For your Direction therefore obſerve, that of the three given Numbers, two always contain a Suppoſition, and the third a Demand.

The Number then on which the Demand lies, muſt always be the third in your ſtating; of the other two, you will be ſure to find one of the ſame Quality with the ſaid third; which being made your firſt, the Number left, muſt, of Conſequence, fall in the ſecond Place, which will bear the ſame Relation to the fourth (or Number ſought) as the firſt does to the third.

The Queſtion being thus ſtated, you muſt (if they are not already ſo) bring your firſt and third Numbers into one Name, and your ſecond into its loweſt Terms; then multiplying your ſecond and third Numbers together, and dividing the Product by your firſt, the Quotient will be the Anſwer of your Queſtion, and of the ſame Name you left your ſecond Number in. See the Examples.

Examples.

Examples.

What must I give for 122 Ells of Holland, if I pay after the Rate of 34 *l.* for 138 Ells?

Ells *l.* Ells.
If 138 cost —— 34 —— what will 122

34

488
366

l. s. d.
138)4148(30 1 1 3/4
414

...8
20

138)160(1
138

22
12

138)264(1
138

126
4

138)504(3
414

90

The Remainder 8, being Parts of a Pound, are multiply'd by 20, to see what Shillings they will produce; and so the other Remainders, by 12, and 4, to bring out the odd Pence and Farthings.

How

How many Yards of Muſlin can I buy for 42 *l.* 12 *s.* if 2 ½ Yards comes to 19 *s.* 6 *d.*?

s.	*d.*		*Yards.*		*l.*	*s.*
If 19	6	buys	2 ½	what will	42	12
2			2		20	
39			5		852	
					2	
					1704	
					5 ½ Yds.	
2)218(					39)8520(218 *farthings*	
109 Yards					78	
					72	
					39	
					330	
					312	
					18	

Proof.

Sums in this Rule, are prov'd by a back-ſtating: For

l. *s.* *Yards,* *s.* *d.*

If 42 12 will buy 109 then 19 6 will buy

20 39 2

852 981 39

2 327

1704 Yards.

1704)4251(2 $\frac{843}{1704}$

3408

·843

2

1686

18 Remainder of the other Stating.

1704)1704(1

···0

If you would know at what Rate you muſt ſell out your Goods by Retail, ſo as to make a propos'd Gain by the whole, add the Money you would gain, to the Sum the whole Goods coſt you; and then ſtate your Queſtion thus: If the whole be ſold for the total of the Coſt and Gain, what muſt any Part?

Example.

Suppoſe I would, by the ſelling of 32 Yards of Broad Cloth, which coſt me 40 *l.* gain 5 *l.* for what muſt I ſell it *per* Yard?

Yards *l.* *Yard.*

If 32 be ſold for 45, what will 1

l.

40 Coſt.

5 Gain.

45 Total.

1

— *l. s. d.*

32)45(1 8 1 ½ *facit.*

32

13

20

32)260(8

256

4

12

32)48(1

32

16

4

32)64(2

64

0

Or if Damage having happen'd to the Cloth, 5 *l.* were to have been loſt by the whole, then the ſaid 5 *l.* muſt have been ſubſtracted from the Coſt, and the Remainder made the ſecond Number, as before.

If you would barter or exchange your Goods for others, firſt find the Value of your own, and then ſee what Quantity of the others the Sum will purchaſe.

Examples.

Examples.

What Quantity of Pepper, at 3 *s.* 6 *d.* *per* lb may I have in Exchange for 426 C. of Tobacco, at 53 *s.* *per* C.?

C. *s.* C.

First, if 1 ——— 53 ——— 426

53

1278

2130

22578

2128 *l.* 18 *s.*

s. *d.* lb *l.* *s.*

Then, if 3 6 ——— 1 ——— 2128 18

2 20

7 42578

2

7)45156(6

6450 *Answer.*

Note.

Some Statings, whose Numbers happen to be even, may be much shorten'd, by dividing their first and second, or first and third Numbers, by any Figure, so that nothing may remain.

Example.

l.	*Men.*	*l.*
If 192|00 would pay	5|00	how many would 17664
Divided by 6)192|00		
	Divided by 6—	2944
Divided by 4) 32		
	Divided by 4—	736
8		5
		8)3680(
	Answer,	460 Men.

The Reasons of this Abbreviation may be seen in the fifth Sort of Reduction of Vulgar Fractions.

More Questions in the Direct Rule of Three.

The Cloathing of a Regiment of 740 Men, comes to 3000 *l.* how much is that for each Man?

Answer, 4 *l.* 1 *s.* 0 *d.* ¼

How long shall I be laying up 10000 *l.* if I put by ½ a Guinea a Week?

Answer, 357 Years, 10 Months, 4 Days.

500 Sea-men are to have 4 *d.* ½ *per* Day each, what will pay them for 23 Months?

Answer, 6037 *l.* 10 *s.*

What will an Estate of 4000 *l. per Annum*, allow a Gentleman to spend a Day?

Answer, 10 *l.* 19 *s.* 2 *d.*

A Gentleman's daily Expences are 13 *s.* 7 *d.* above which, he yearly lays up 600 Nobles, at 6 *s.* 8 *d.* each, what is his Estate worth *per Annum*?

Answer, 447 *l.* 17 *s.* 11 *d.*

A Man

A Man owing 736 *l.* 10 *s.* compounds with his Creditors for 7 *s.* 9 *d. per l.* what will that amount to?

Answer, 285 *l.* 7 *s.* 10 *d.* $\frac{1}{2}$

If at 5 *s. per* Ell, I gain 8 *l. per Cent.* by my Cloth, what shall I gain *per Cent.* if I sell the Ell at 6 *s.* 3 *d.*?

Answer, 10 *l.*

If Tobacco, which cost 13 *d. per* lb be sold for 18 *d. per* lb, what is gain'd *per Cent.*

Answer, 27 *l.* 15 *s.* 6 *d.* $\frac{1}{2}$

Bought 5 Pieces of Holland, each containing 56 Ells *Flemish*, at 3 *s.* 2 *d. per* Ell, what shall I gain in the whole, if I sell it for 5 *s.* 8 *d. per* Ell *English*?

Answer, 3 *l.* 5 *s.* 4 *d.*

I have by me 96 lb of Cloves, which cost me 58 *l.* but some Damage having happen'd to them, I am willing to lose 8 *l.* in the whole; at what Rate must I sell them *per* Ounce?

Answer, 7 *s.* 3 *d.*

A Merchant sends over to *France* 482 Tuns of Lead, at 4 *l.* 10 *s. per* Fother, i. e. 19 $\frac{1}{2}$ C. what Quantity of Wine, at 30 *l. per* Pipe, may he expect in Return?

Answer, 74 Pipes, 19 Gallons.

A Merchant sends to *Spain* 1300 Pieces of Broad Cloth, each Piece 47 Yards, at 15 *s.* 6 *d. per* Yard, to have Returns from thence; the one half in Wine, at 65 *l. per* Tun; the other half in Oranges, at 3 *l.* 10 *s. per* Chest; what Quantity of each will he have?

Answer, { 394 Tuns, 2 Hogsheads, 26 Gallons of Wine
6764 Chests of Oranges.

Two Men part, at the same Time from the same Place; the one travels North 32 Miles a Day, the other 36 Miles a Day South, how long will it be before they are 2000 Miles asunder?

Answer, 29 Days, 9 Hours, 52 Minutes.

The Indirect RULE *of* THREE,

DIFFERS, in its Operation, from the Direct, in that, after the Queſtion is ſtated, and the Numbers of the Stating prepar'd, your firſt and ſecond muſt be multiply'd together, and your third Number be your Diviſor. The Quotient, as before, will be the Anſwer.

Examples.

What Number of Men muſt be employ'd, to finiſh, in 12 Days, what 43 Men would be 35 Days about?

Days	Men	Days
If 35	43	12

43

105
140

12)1505(5
Anſwer, 125 Men

How many Yards of Stuff 3 *qrs.* wide, will hang a Room which requires 420 Yards of 5 *qrs.* wide?

qrs.	*Yards*	*qrs.*
If 5	420	3

5

3)2100(

700 Yards

To

To know whether a Queſtion belongs to the Direct *or* Indirect Rule of Three.

Obſerve. If the third Number, being more than the firſt Number, requires more; or being leſs, requires leſs; 'tis *Direct*; but if the third Number, being more, requires leſs; or being leſs, requires more; 'tis *Indirect*.

More Queſtions in the Indirect Rule of Three.

If I lend *A.* 136 *l.* for 3 Months, how long muſt I keep 42 *l.* of his, to requite my ſelf?

Anſwer, 9 Months, 2 Weeks, 6 Days.

If 46 Clerks in 32 Days finiſh a Piece of Writing, in what Time would 55 Clerks accompliſh the ſame?

Anſwer, 26 Days, 18 Hours, 29 Minutes.

A Garriſon conſiſting of 1539 Men, being beſieg'd, have Proviſions only for 12 Days; but it being neceſſary they ſhould hold out 3 Weeks, how many Men muſt be ſent out?

Anſwer, 660 Men.

The DOUBLE RULE *of* THREE.

QUESTIONS in this Rule have five Numbers propos'd, and are generally anſwer'd by two Statings; of which one ſometimes happens to be *Indirect*, as in the ſecond Example.

Examples.

Examples.

Example 1.

The Carriage of 32 hundred Weight 56 Miles, comes to 12 *s.* after the ſame Rate, what muſt I pay to have 78 hundred Weight carry'd 94 Miles?

C. *s.* C.
First, if 32 —— 12 —— 78
12
—— *s.* *d.*
32)936(29 3 *fract.*
64
296
288
8
12
32)96(3
96
0

Miles *s.* *d.* Miles
Then, if 56 —— 29 3 —— 94
12
351
94
1404
3159
12
56|32994|589(1
280
2|0(4|9
499
448 2 *l.* 9 *s.* 1 *d.* *Anſwer.*
514
504
10

Mul-

Note. It had been the same Thing, if the Miles had been made the first and second Numbers of the first Stating; and the C. Weights the first and second Numbers of the last.

Note also, it may be done in one Stating, thus:

C.	s.	C.
If 32	12	78
56 Miles.		94 Miles.
192		312
160		702
1792		7332
		12

s. d.

1792)87984(49 1

7168 or

l. s. d.

16304 2 9 1

16128

176

12

1792)2112(1

1792

320

Example

Example 2.

How many Men must be employ'd to reap 420 Acres in 17 Days, if there were requir'd 37 Men to reap 54 Acres in 5 Days?

Acres Men Acres

First, if 54 —— 37 —— 420

37

2940

1260

Days Men Days

Then, if 5 —— 287 —— 17

5

Men

17)1435(84 *Answer.*

136

75

68

7

54)15540(287

108

474

432

420

378

42

Note. If you would work such Questions of the *Double Rule of Three*, as have one of their Proportions Indirect, by one Stating; you must multiply the third Number of your Stating, by that Number you would otherwise have plac'd under your first; and your first Number by that you would have plac'd under the third; as in this

Example.

Example.

Acres	Men	Acres	
If 54	37	420	The Number of Days which have relation to the 54 Acres.
* 17		5	
378		2100	
54		37.	
918		14700	
		6300	

* The Number of Days which have Relation to the 420 Acres.

Men.

918)77700(84 *Answer*, as before.
7344
4260
3672
588

Dr. *Harris*, in his *Lexicon Technicum*, teaches another Way of ranging the five Numbers given in a *Double Rule of Three* Question; which, according to the following Rules, gives the Solution, whether the Proportion be direct or indirect. Take this Method in his own Words.

I. "Observing, that the given Terms are always "five, whereof three are conditional and antecedent, "or suppositious; the other two demand the Question, and are Consequents answering some of the "former Antecedents; insomuch, that with the Answer there will be as many Consequents as Antecedents, which must match one another in the same "Denomination exactly.

II. "For the right placing of the Question and "Terms, the three Terms of the conditional Part are "duly to be regarded: Let that which is the principal "Cause of Loss or Gain, Increase or Decrease, Action

"or

" or Paſſion, be put in the firſt Place; and that which " betokeneth the Space of Time, Diſtance of Place, &c. " be put in the ſecond Place; and the remaining " Part in the third. The conditional Part thus ſtated, " the other two Terms, wherein the Demand lies, muſt " be plac'd ſo under the former Terms, that they may " correſpond one with another.

Rule 1.

" Then, if the Blank, or Place ſought, fall under " the third Term, multiply the three laſt Terms for a " Dividend, and the two firſt for a Diviſor; and the " Quotient gives the ſixth Term requir'd.

Rule 2.

" But if the Blank fall under the firſt or ſecond " Terms, multiply the 1ſt, 2d, and 5th Terms for a " Dividend, and the 3d and 4th for a Diviſor; the " Quotient gives the Anſwer.

Example 1.

" If 12 Rods of Ditching be done by 2 Men in " 6 Days, how many Rods ſhall be wrought by 8 Men " in 24 Days?

Anſwer 192.

The Numbers being ſtated as before directed, they will ſtand thus, the Blank falling under the third Place.

Men	Days	Rods
2	6	12
8	24	

Therefore

Therefore by the first Rule, the three last Terms, viz. 12, 8, and 24, being multiply'd into each other, give 2304 for a Dividend; and the two first Terms, viz. 2 and 6, multiply'd together, give 12 for a Divisor, which quotes 192, the Answer.

Example 2.

If 2 Men work 12 Rods in 6 Days, how many Men will work 192 Rods in 24 Days?

Men	Days	Rods
2	6	12
	24	192

Here, according to the second Rule, the first, second, and fifth Terms multiply'd, give 2304, which divided by 288, the Product of the third and fourth Numbers, quotes 8, the Answer.

More Examples.

If 400 Pecks of Corn will serve 32 Horses 108 Days, what Quantity will 500 Horses eat in 20 Days?

Answer, 1157 Pecks, 1 qr.

If 56 Gallons of Drink serve 25 Persons 120 Days, how long will 200 Gallons serve 12 Persons?

Answer, 892 Days.

CHAP. IV.

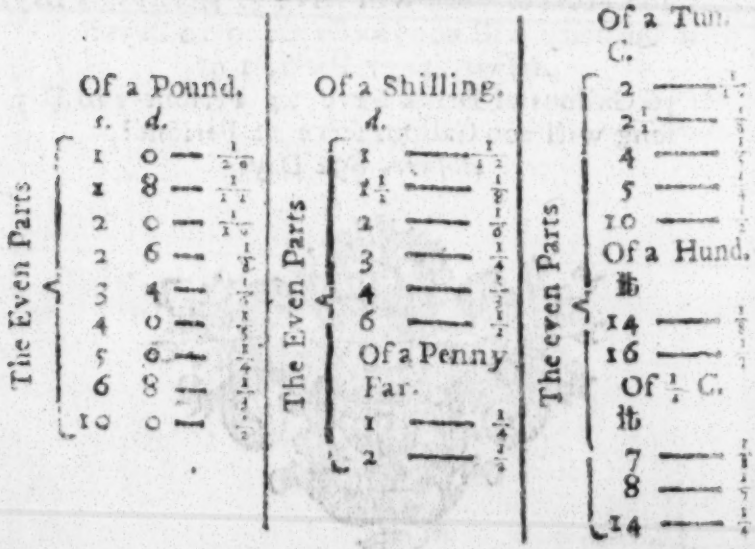
PRACTICE, *and* TRETT *and* TARE.

BY PRACTICE Merchants compendiously cast up the Price of their Commodities.

And by TRETT and TARE deduct their Allowances.

Both these Rules will be best explain'd by Examples; and both require the perfect Knowledge of the following

TABLE.



Rules

Rules with Examples.

1. When the Price is such a Number of Pence as make an even Part of a Shilling, divide the Quantity of Goods by such Part, and the Quotient will be the Answer in Shillings.

Example.

Suppose you would know the Price of 5296 Ounces of Gum, at 6*d. per* Ounce; then

	oz.
6*d.* being $\frac{1}{2}$ of 1 Shilling.	5296

2648 Shillings is the Answer.

For were the Price 12*d.* or 1*s.* the Number of Ounces would be the Number of Shillings they would cost: Therefore, the Price being 6*d.* the $\frac{1}{2}$ of a Shilling; the Answer must be but $\frac{1}{2}$ so many Shillings. So, at 1*d.* 1*d.* $\frac{1}{2}$, 2*d.* 3*d.* or 4*d.* 'tis but taking the $\frac{1}{12}$, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{4}$, or $\frac{1}{3}$ Parts of the Quantity of Goods, and the Quotient (as aforesaid) will be the Answer in Shillings, which divided by 20, gives the Pounds.

Note. If any thing remains in dividing by the said Parts, (Pence being the next Denomination) it must be multiply'd by 12, the Pence in 1 Shilling; and the Product divided again by the said Part; and if any thing remains there, it must be multiply'd by 4, and still divided by the said Part, to produce Farthings.

Example.

	oz.	*d.*
	5243	at 1 $\frac{1}{2}$ *per* Ounce.
d.		
1 $\frac{1}{2}$ $\frac{1}{8}$	65|5	4 $\frac{1}{2}$

32*l.* 15*s.* 4*d.* $\frac{1}{2}$ *facit.*

2. If the Pence of the Price are not an even Part of a Shilling, it will require more than one Diviſion, to find the Coſt of the Goods. Thus at 5 *d.* or any Number of Pence between 6 and 12.

Examples.

	lb	*d.*		lb	*d.*
	527 at 5 *per* lb			436 at 9 *per* lb	
d.			*d.*		
4 $\frac{1}{3}$	175	8	6 $\frac{1}{2}$	218	
1 $\frac{1}{4}$	43	11	3 $\frac{1}{2}$	109	
	21|9	7		32|7	
	10 *l.* 19 *s.* 7 *d. facit.*			16 *l.* 7 *s. facit.*	

In the firſt of theſe, 5 *d.* is taken thus: 4 *d.* is the $\frac{1}{3}$ of a Shilling, or the top Line; and 1 *d.* the $\frac{1}{4}$ of the 4 Pence

In the ſecond, the $\frac{1}{2}$ of a Shilling is firſt taken for 6 *d.* and then the $\frac{1}{2}$ of that 6 *d.* for 3 *d.*

3. If the Price is both Pence and Farthings, for the Pence as before, and for the Farthings, take the even Parts of a Penny: thus.

Example.

		oz.	*d.*
		532 at 1 $\frac{1}{4}$ *per* Ounce.	
1 Penny,	$\frac{1}{12}$	44	4
1 Farthing,	$\frac{1}{4}$	11	1
		5|5	5

2 *l.* 15 *s.* 5 *d. facit.*

4. When

4. When the Price is more than 1 *s.* and less than 2*s.* leave the top Line for the Shilling, and take your Parts, as before, for the remaining Pence.

Example.

	lb	*d.*
d.	5437 at	19 ½ *per* lb
6 ½	2718	6
1 ½ ¼	679	7 ½
	883|5	1 ½

441 *l.* 15 *s.* 1 *d.* ½ *facit.*

5. If the Price is two or more Shillings, with Pence, *&c.* either take the even Parts of a Pound from your top Line for the Shillings, which will give you the Price in Pounds; or multiply your top Line by the Number of Shillings, which will give the Answer in Shillings; still working for the Pence as before. See both Ways in the

Example.

	oz.	*s. d.*		*oz.*	*s. d.*
	5263 at	2 6 *per* Ounce.		5263 at	2 6 *per* Ounce.
s. d.				2	
2 6 ½	657	17 6	*d.*	10526	
			6 ½	2631	6
				1315|7	6

657 *l.* 17 *s.* 6 *d. facit.*

The first of the foregoing Examples is thus done: Had the Price been 1 *l.* or 20 *s.* 'tis plain it would have come to as many Pounds as there were Ounces; therefore at 2 *s.* 6 *d.* which is the ⅛ of a Pound, it must come to the ⅛ of so much Money.

The other is done, by supposing the top Line at 1 *s.* then for 2 *s.* it must be twice so much; and for the 6*d.* ½ the top Line, or Value of a Shilling, must be added. See both Ways in another

Example.

	lb	*s.*	*d.*
	5276 at	19	9 *per* lb
s.			
10 ½	2638		
5 ½	1319		
4 ½	1055	4	
6*d* ½	131	18	
3 ½	65	19	
	5210 *l.*	1 *s.*	*facit.*

	lb	*s.*	*d.*
	5276 at	19	9 *per* lb
	19		
	47484		
d.	5276		
6 ½	2638		
3 ½	1319		
	10	20	1		
	5210 *l.*	1 *s.*	*facit.*

6. When the Price is any Thing between one and two Pounds, leave the top Line for the Pound, and take your Parts for the Remainder.

Example.

s	lb	*s.*	*d.*
d.	5384 at	22	6 *per* lb
2 6 ½	673		
	6057 *l.* *facit.*		

7. When the Price is two or more Pounds, multiply the top Line by the Number of Pounds; and for the Remainder, take Parts as before.

Example.

Example.

lb l. s. d.
2364 at 4 18 10 ½ *per* lb.
4

s.		9456		
10	½	1182		
5	¼	591		
2	⅕	236	8	
1	½	118	4	
6d.	¼	59	2	
3	½	29	11	
1	½ ½	14	15	6

11687 *l.* 00 *s.* 6 *d. facit.*

8. When with the given Quantity there are odd Parts, such Parts must be taken from the given Price; as in the following

Examples.

C. *qrs.* *l.* *s.*
365 2 at 5 5 *per* C.
5

l.		1825		
5	¼	91	5	
2 *qrs.*	½	2	12	6

1918 *l.* 17 *s.* 6 *d. facit.*

	C.	qrs.	lb	l.	s.	d.	
	7365	3	14	at 8	19	6	per C.
	8						
s.	58920						
10 1/2	3682	10					
5 1/2	1841	5					
4 1/5	1473	0					
6 d. 1/10	184	2	6				
2 qrs. 1/2	4	9	9				
1 1/2	2	4	10	1/2			
14 lb 1/2	1	2	5	1/4			
	66108	l.	14	s.	6	d.	3/4 facit.

As in the first of these, for the 2 *qrs.* ½ the Price of the C. is taken; so in the second, not only ½ the Price of the C. is taken for 2 *qrs.* but also ½ the Price of 2 *qrs.* for 1 *qr.* and ½ that again for 14 lb. See more

Examples.

	Tuns.	C.	qrs.	lb	l.	s.	d.	
	573	13	2	18	at 9	12	10	per Tun.
	9							
	5157							
10 s. 1/2	286	10						
2 1/5	57	06						
10 d. 1/12	23	17	6					
10 C. 1/2	4	16	5					
2 1/5		19	3	1/4				
1 1/2		09	7	1/2				
2 qrs. 1/2		04	9	3/4				
14 lb 1/4		01	2	1/4				
2 1/7			2					
2 1/7			2					
	5531	l.	05	s.	1	d.	3/4	facit.

527 lb

lb	oz.	drams.	l.	s.	d.
527	13	15	at 2	8	7 ½ per lb.
2					
1054					
5 s. ¼ —	131	15			
2 ⅒ —	52	14			
1 ½ —	26	07			
6 d. ½ —	13	03	06		
1 ½ ¼ —	3	05	10 ½		
8 oz. ½ —	1	04	03 ¾		
4 ¼ —		12	01 ¾		
1 ¼ —		03	00 ¼		
8 drs. ½ —		01	06		
4 ½ —			09		
2 ½ —			04 ½		
1 ½ —			02 ¼		

1283 l. 07 s. 08 d. *facit.*

The last Sum another Way.

lb	oz.	drams.	l.	s.	d.
527	13	15	at 2	8	7 ½ per lb
48					
4216					
2108					
6 d. ½ —	263	6			
1 ½ ¼ —	65	10 ½			
8 oz. ½ —	24	3 ¾			
4 ½ —	12	1 ¼			
1 ¼ —	3	0 ¼			
8 drams ½ —	1	6 —			
4 ½ —		9 —			
2 ½ —		4 ½			
1 ½ —		2 ¼			
256617	8				

1283 l. 7 s. 8 d. *facit.*

Another

Another Example.

		lb Troy.	oz.	dwts.	grs.		l.	s.	d.	
		736	11	12	13	at	23	16	4	per lb
		23								
		2208								
		1472								
10 oz.	$\frac{1}{2}$	368								
5	$\frac{1}{2}$	184								
1	$\frac{1}{5}$	36	16							
4 d.	$\frac{1}{3}$	12	05		4					
6 oz.	$\frac{1}{2}$	11	18		2					
4	$\frac{1}{3}$	7	18		9	$\frac{1}{4}$				
1	$\frac{1}{4}$	1	19		8	$\frac{1}{4}$				
10 dwts.	$\frac{1}{2}$		19		10					
2	$\frac{1}{5}$		3		11	$\frac{1}{2}$				
12 grs.	$\frac{1}{4}$				11	$\frac{3}{4}$				
1	$\frac{1}{12}$					$\frac{3}{4}$				
							17552	2	9	$\frac{1}{2}$ facit.

By

By the *Rule of Three* thus:

lb	*l.*	*s.*	*d.*		lb	*oz.*	*dwts.*	*grs.*
If 1—cost—	23	16	4	what will	736	11	12	13

12 20 12

12 476 8843
20 12 20

240 5716 176872
24 24

960 707491
480 353745

5760 4244941
5716

25469646
4244941
29714587
21224705

576|0)24264082756|(12)42125144|10

1224 2|0)35104|2

720 17552 2 1 ¼

Fan 17552*l.* 2*s.* 10*d.* ¼

1448

Three Farthings more than by Practice loft there, by the Fractions remaining. ·2962

·827

2515

2116
4

576|0)8464(1
270

Proof.

Sums in this Rule may be prov'd either by taking the Parts two Ways, as the laſt Example but one; or by the *Rule of Three*, as the laſt.

Abbreviations.

As this whole Rule is indeed nothing elſe, it may be thought ſtrange to mention ſhort Ways here, in a particular Section; but as there are Degrees of Compariſon, ſo even ſhort Ways may be more ſhorten'd.

1. The Value of any Quantity (the given Price of one of which is an even Number of Shillings) may be moſt compendiouſly found, by multiplying the ſaid Quantity by ½ their Number, doubling the Units of the firſt Product for Shillings, the reſt being Pounds.

Example.

5276 Ells of Holland, at 8 *s. per* Ell.

4

2110:8 *Anſwer.*

2. If the Price is an odd Number of Shillings, it is but doing as before, and adding $\frac{1}{20}$ of the top Line to the Product.

Example.

Yards.	*s.*
5278	at 15 *per* Yard.
7	
3694	12
11. $\frac{1}{20}$ 263	18
3958 *l.*	10 *s. Anſwer.*

3. Were

3. Were there Pence in the Price, their Parts might alſo be eaſily taken in the ſame Method.

Example.

	lb	s.	d.
5384 at	7	7	½ per lb
	3		
	1615	4	
1 s. 1/20	269	4	
6 d. ½	134	12	
1 ½ ¼	33	13	

2052 *l.* 13 *s. facit.*

4. Another ſhort and uſeful Way, when the Quantity is ſmall, is to multiply the Price by it; thus if your Quantity is expreſs'd by one Figure, 'tis done by one Line.

Example.

	l.	*s.*	*d.*
5 Yards of Velvet at	1	13	6 *per* Yard.
		5	

8 *l.* 7 *s.* 6 *d. facit.*

5. So any Quantity that can be expreſs'd by 2 Figures, and ſome of 3, may be eaſily and ſpeedily done thus: Find out what two Figures multiply'd together, will produce the given Quantity, (as ſuppoſe 32 Yards or Pounds, *&c.* the given Quantity, which is produc'd by the Multiplication of 8 by 4) and multiply the Price by one of the ſaid Figures; and the Product of that, multiply'd again by the other, will give the Anſwer.

Examples.

Yards. *s.* *d.*
32 at 15 8 ½ *per* Yard.
8

The Value of 8 Yards 6 5 8—
which multiply'd by 4

gives 25 *l.* 21. 8 *d.* the Price of 32 Yards
—4 times 8 being 32

Yards. *l.* *s.* *d.*
144 at 1 5 6 *per* Yard.
12

15 6 0
12

183 *l.* 12 *s.* 0 *d.* *facit.*

6. If no two Figures will exactly produce those given, take such as will give the nearest Product to them; which will generally be within one or two, more or less; the Value of which must be accordingly added or subtracted.

Example.

lb *l.* *s.* *d.*
55 at 1 10 9 *per* Ell.
9

the Price of 9 lb 13 16 9
which multiply by 6

gives the Price of 54 lb 83 00 6
to which the Price of 1 lb added 1 10 9

lb
84 11 3 the Value of 55

So had it been multiply'd by 7 and 8, which would have given the Value of 56 lb too much by 1 lb, the Price of 1 lb muſt have been ſubſtracted.

7. If the Quantity has odd Parts, it will be eaſy taking the Value of ſuch Parts from the given Price; as in the following

Example.

Yds.	*l.*	*s.*	*d.*	
43 ½	at 2	12	7	*per* Yard.
			7	
	18	8	1	
			6	
	110	8	6	
qrs.		2	12	7
2 ½		1	6	3 ½
	114	7	4 ½	*facit.*

TRETT *and* TARE,

ARE Allowances made to Merchants in buying their Goods.

Tare, of what they can agree for *per* the Whole, *per* Cheſt, *&c.* or *per* C. for the Weight of the Bag, Box, Cheſt, *&c.* which contains them.

Trett, for the Waſte, Moats, or Duſt among them; being always 4 lb *per* 104 lb.

There is alſo another Allowance ſometimes given of 2 lb for every 3 C. for the Turn of the Scale, call'd Cloff, or Clough.

Note. The whole Weight, before any Allowances are made, is call'd Groſs; when Part is deducted, the

Remainder is call'd Suttle; but when all are taken from it, what's left, is call'd Neat.

Rules with Examples.

1. The Tare of any Quantity of Goods may eaſily be found, if at ſo much in the whole, only by ſubſtracting the ſaid Allowance from the Groſs Weight; if at ſo much *per* Cheſt, *&c.* by multiplying the Pounds Tare by the Number of Cheſts, *&c.* and ſubſtracting as before; and if at ſo much *per C.* by taking ſuch Part, or Parts of the Groſs Weight, as the Allowance is of a *C.*

Examples.

Firſt Sort. Suppoſe 15 *C.* 2 *qrs.* 13 *l.* Tare, were allow'd on 456 *C.* 1 *qr.* 19 lb of Tobacco, what would be the Neat Weight.

	C.	*qrs.*	lb	
From	456	1	19	Groſs.
Subſtract	15	2	13	Tare.
Remainder	440	3	6	Neat.

Second Sort. What's the Neat Weight of 3 Frails of Raiſins, each weighing 3 *C.* 2 *qrs.* 10 lb Groſs; Tare at 20 *l. per* Frail.

C.	*qrs.*	lb		lb
3	2	10		20
		3	Frails.	3 Frails.
10	3	2	Groſs.	60 lb or 2 *qrs.* 4 lb
	2	4	Tare.	
10	0	26	Neat.	

Third

	C.	qrs.	lb			lb
Third Sort.	246	3	12	Groſs.	Tare	14 *per C.*
lb						
14 1/8	30	3	12	Tare.		
	216	0	00	Neat.		

	C.	qrs.	lb			lb
Again,	364	1	19	Groſs.	Tare	16 *per C.*
lb						
16 1/7	52	0	06 1/2	Tare.		
	312	1	12 1/2	Neat.		

14 or 16 Pounds may be call'd the Standards of Tare; for from them may any other Number of Pounds, more or leſs, be taken, as in the following

Examples.

	C.	qrs.	lb			lb
	573	2	13	Groſs.	Tare	17 *per C.*
lb						
14 1/8	71	2	22 1/2			
2 1/7	10	0	27			
1 1/2	5	0	13 1/2			
	87	0	07	Tare.		
	486	2	06	Neat.		

	C.	qrs.	lb		lb
	548	3	11	Groſs.	Tare 10 *per* C.
lb					
16 1/7	78	1	17 1/2		
8 1/2	39	0	22 3/4		
2 1/4	9	3	05 1/2		
	49	0	00 1/4	Tare.	
	499	3	10 3/4	Neat.	

Note. 'Tis firſt found what Tare 16 lb would produce; becauſe 8 lb being the 1/14 Part of a C. would be a troubleſome Diviſor.

2. TRETT being always 4 lb *per* 104 lb the conſtant Method of finding it, is by taking the 1/26 Part of the Line it is to be deducted from, 4 times 26 being 104.

Examples.

	C.	qrs.	lb		lb	lb
	428	1	19	Groſs.	Trett 4 *per* 104	
lb						
4 1/26	16	1	25 1/2	Trett.		
facit	411	3	21 1/2	Neat.		

836

	C.	qrs.	lb	lb
	836	2	17	Groſs. Tare 22 *per* C.
lb				
16 1/7	119	2	2 1/4	Trett 4 lb *per* 104 lb.
4 1/4	29	3	14 1/2	
2 1/2	14	3	21 1/4	
	164	1	10	Tare.
	672	1	07	Suttle.
lb				
4 1/28	25	3	12	Trett.
facit	646	1	23	Neat.

3. Clough (which is 2 lb for every 3 C.) is found, by firſt dividing the hundreds of the Line it is to be taken from by 3, which brings them into 3 C's; then 2 lb being to be allow'd for every 3 C. as many 3 C's as it produces, ſo many 2 lb's it will allow; then dividing by 56, (the double Pounds in a Hundred) the Quotient will be Hundreds, and the Remainder double Pounds; to which adding what may be allow'd for the odd Hundreds, Quarters, and Pounds of the given Weight, it makes the whole Clough; which ſubſtracted from the ſaid given Weight, leaves the Neat.

Examples.

Examples.

C.	qrs.	lb		
5647	3	13		Groſs.
33	2	13	¼	Clough.
5614	0	27	¾	Neat.

lb C.
Clough 2 for 3
3)5647(1

C. qrs. lb
56)1882(33 2 12
168 1 ¼

202 33 2 13
168

14). 34(2
28

6

Note. The Remainder 34 (which are double Pounds) is divided by 14, (the double Pounds in a *qr.*) to bring the ſaid Remainder into Quarters of an Hundred.

Note alſo. The 1 lb ¼ is allow'd for the odd Hundred, 3 *qrs.* and 13 lb.

Example 2.

What's the Neat Weight of 3 Hogſheads of Tobacco weighing, *viz.*

Number

Number	C.	qrs.	lb		
1 ——	5	3	18		
2 ——	4	2	11		
3 ——	5	1	19		
	15	3	20	Grofs.	Tare 7 lb *per* C.
lb					Trett 4 lb *per* 103 lb
14 1/8	1	3	27		Clough 2 lb for 3 C.
7 1/2		3	27	1/2	Tare.
	14	3	20	1/2	Suttle.
4 1/25		2	8	1/4	Trett.
	14	1	12	1/4	Suttle.
			9		Clough
	14	1	3	1/4	Neat.

C. 3)14(4 2

CHAP.

CHAP. V.

Of INTEREST.

INtereſt is either { Simple, or Compound, } { which ariſes only from the Principal. / which ariſes both from Principal and Intereſt. }

Simple Intereſt.

IS work'd as in the following

Examples.

Example 1. What's the Intereſt of 429 *l.* for a Year, at 6 *l. per Cent. per Annum?*

l.	*l.*	*l.*
If 100	6	429
		6
		25|74
Facit 25 *l.* 14 *s.* 9 *d.* ½		20
		14|80
		12
		9|60
		4
		2|40

To find the Interest of any Sum for 2 or more Years, multiply the Year's Amount by the Number of Years requir'd.

Note. The cutting off two Figures to the right Hand, divides the Lines so done by 100. See Abreviations of Division.

Ex. 2. What's the Interest of 572 *l.* for 8 Months, at 5 *l. per Cent. per Annum?*

l.	*l.*	*l.*		*l.*	*s.*
If 100	5	572		28	12
		5	*M.*		
			6 ½	14	6
		28|60	2 ⅓	4	15 4
		20			
		12|00		19 *l.* 1 *s.* 4 *d. fac.*	

If the Time is Weeks, or Days, instead of taking the even Parts of a Year, as for Months, it must be done by a *Rule of Three* Stating.

Ex. 1.

Ex. 1. What's the Intereſt of 321 *l.* 16 *s.* 8 *d.* for 3 Weeks, at 6 *l. per Cent. per Annum?*

	l.	*l.*	*l.*	*s.*	*d.*
If	100	6	321	16	8
					6
			19	31	00
				20	
				6	20
				12	
				2	40
				4	
				1	60

Facit 19 *l.* 6 *s.* 2 *d.* $\frac{1}{4}$ for a Year.

	Weeks.	*l.*	*s.*	*d.*		*Weeks.*
Then, if	52	19	6	2	$\frac{1}{4}$	3
		20				
		386				
		12				
		4634				
		4				
		18537				
		3	4			
	52)55611(1069(1					
	52					
	12)267(3					
	36					
	312	2	2			
	1 *l.* 2 *s.* 3 *d.* $\frac{1}{4}$ *facit.*					
	491					
	468					
	23					

Ex. 2.

Ex. 2. What Interest is now due on a Bond of 420*l.* 10*s.* commencing Interest at 5*l.* 10*s.* *per Cent. per Annum*, *July* the 10th, 1713; this being *March* the 25th 1715?

l.	*l.*	*s.*	*l.*	*s.*
If 100	5	10	420	10
				5
		s.	21	02 10
		10 ½	210	5
			23	12 15
				20
23*l.* 2*s.* 6*d.* ½ for a Year.			2	55
				12
			6	60
				4
			2	40

July	21
August	31
September	30
October	31
November	30
December	31
January	31
February	28
March	25
	258

Ex. 1. What's the Intereſt of 321 *l.* 16 *s.* 8 *d.* for 3 Weeks, at 6 *l. per Cent. per Annum?*

	l.	*l.*	*l.*	*s.*	*d.*
If	100	6	321	16	8
					6

19|31 00 0
20

6|20
12

2|40
4

1|60

	Weeks.	*l.*	*s.*	*d.*		*Weeks.*
Then, if	52	19	6	2	¼	3

20

386
12

4634
4

18537
3 4

52)556111(1069(1
52 12)267(3
·361 2|2
312 1 *l.* 2 *s.* 3 *d.* ¼ *fact.*
·491
468
·23

Ex. 2. What Interest is now due on a Bond of 420*l.* 10*s.* commencing Interest at 5*l.* 10*s.* *per Cent. per Annum*, *July* the 10th, 1713; this being *March* the 25th 1715?

l.	*l.*	*s.*	*l.*	*s.*
If 100	5	10	420	10
				5
		s.	21	02 10
		10 ½	210	5
			23	12 15
				20
23*l.* 12*s.* 6*d.* ½				
for a Year.			2	55
				12
			6	60
				4
			2	40

July	21
August	31
September	30
October	31
November	30
December	31
January	31
February	28
March	25
	258

Days.	l.	s.	d.	Days.
Then, if 365	23	2	6 ½	258

20

462
12

5550
4

22202
28

177616
111010
44404

4

365)57281216(15693(11
365

2078
1825

2531
2190

3411
3285

1266
1095

171

12)3925(11

210)3216

16 l. 6 s. 11 d. ½ for 258 Days
23 l. 2 s. 6 d. ½ for 2 Years

39 l. 9 s. 5 d. ¾ total Interest

Another Way to cast up Interest, when the Principal has odd Money in it, and the Time Weeks or Days.

Rule.

Bring your Sum into Pence, and multiply it by the Number of Days; and, if at 5 *l. per Cent.* divide the

the Product by 7300, the Quotient gives the Answer in Pence. *Note.* The Number 7300 is found by multiplying 365 by 100, and dividing by 5.

Example.

What's the Interest of 432 *l.* 12 *s.* 6 *d.* for 8 Days, at 5 *l. per Cent. per Annum?*

```
                 l.   s.  d.
               432   12   6
                20
               ----
               8652
                 12
               ----
             103830
                  8  12
             ------
73|00)8306|40(113(5
      73          ----
      ---          9 s. 5 d. ¼ fact.
      100
       73
      ---
       276
       219
       ---
        5740
           4
73|00)229.60(3
       219
       ---
        10
```

If you would cast up Interest at 6 *l. per Cent.* by this Rule, you must add ⅕ of the Quotient, to the Interest produc'd at 5 *l. per Cent.* and so at other Rates, it is but adding or substracting such and such Parts of the Quotient:

tient to or from what it produces at 5 *l.* For Inſtance, ſuppoſe the laſt Queſtion done by the common Way for an

Example.

l. *s.*
420 10 Principal.
20

8410
12

100920 Pence.
623 the Number of Days.

302760
201840
605520

d.
73|00)628=31|60(8612 $\frac{4}{73}$
584 $\frac{1}{73}$ 862

447 12)9473(5
438 789

93
73 39 *l.* 9 *s.* 5 *d.* $\frac{4}{73}$ *facit.*

201
146

5560
4

73|00)222|40(3
219

3

E Nat

Note. The Rate here being 5 *l.* 10 *s.* and 10 *s.* being the $\frac{1}{10}$ of 5 *l.* there is therefore added $\frac{1}{10}$ of the Quotient, or the Amount, at 5 *l. per Cent.*

More Examples in Simple Intereſt.

At 6 *l. per Cent.* what will 589 *l.* come to in a Year?

Anſwer, 35 *l.* 6 *s.* 9 *d.* $\frac{1}{2}$

What will the ſame Sum, at the ſame Rate, amount to in 8 Years?

Anſwer, 282 *l.* 14 *s.* 4 *d.*

What's the Intereſt of 7020 *l.* for 5 Months, at 5 *l. per Cent. per Annum?*

Anſwer, 146 *l.* 5 *s.*

What is a Week's Intereſt of 1000 *l.* at 7 *l. per Cent.*

Anſwer, 1 *l.* 6 *s.* 11 *d.*

What will the Intereſt of 5429 *l.* 10 *s.* 8 *d.* come to in 20 Days, at 5 *l. per Cent.*

Anſwer, 14 *l.* 17 *s.* 6 *d.*

What Intereſt is now due on a Navy-Bill, commencing Intereſt at 6 *l. per Cent. per Annum, June* the 4th, 1712, this being *January* the 20th, 1714, the Principal being 836?

Anſwer, 80 *l.* 7 *s.* 10 *d.*

Compound Intereſt,

AS was before ſaid, ariſes both from the Principal and Intereſt, (*i. e.*) when Intereſt on Money becoming due, and not paid, the ſame Rate is allow'd on the unpaid Intereſt, as was before on the Principal.

Therefore, to work Sums in this Rule, after having found the firſt Year's Intereſt, as before, add it to the

Principal, and find the Interest of the Sum; and so continue to add every Year's Produce, still accounting the Sum a new Principal.

Example.

What will be the Amount of 400 *l.* for born 3 Years and $\frac{1}{2}$, at 6 *l. per Cent. per Annum*, Compound Interest?

l. *l.* *l.*
If 100 —— 6 —— 400
6

l. 24|00

l. *l.* *l.*
If 100 —— 6 —— 424
6

l. 25|44
20

s. 8|80 *s.*
12

d. 9|60 *d.*
4

1|40

l.
424
25 8 9 ½

l.	l.	
If 100	6	449 8 9 ½
		6

l. 26|96 12 9—
20

s. 19|32
12

d. 3|93
4

3|72

l.	s.	d.	
	449	8	9 ½
	26	19	3 ¾

l.	l.	
If 100	6	476 8 1 ¼
		6

l.	s.	d.	
	28	11	8
M.			
6 ½	14	4	10
	476	8	1 ¼
	490	13	11 ¾

Total Amount,

l. 28|58 8 7 ½
20

s. 11|68
12

d. 8|23
4

94

Or,

Or, more plain:

	l.	*s.*	*d.*
Interest the 1st Year	24	0	0—
2d———	25	8	9 $\frac{1}{2}$
3d———	26	19	3 $\frac{3}{4}$
$\frac{1}{2}$ Year—	14	5	10
Total Interest	90	13	11 $\frac{1}{4}$
Principal	400	0	0
Total Amount.	490	13	11 $\frac{1}{4}$

More Examples.

What will 1000 *l.* amount to in 3 Years, at 6 *l.* for *Cent. per Annum*, Compound Interest?

Answer, 1191 *l.* 0 *s.* 3 *d.* $\frac{3}{4}$

At 5 *l.* 10 *s. per Cent. per Annum*, Commpund Interest, what will 560 *l.* 10 *s.* 9 *d.* amount to, forborn 5 Years and an half?

Answer, 752 *l.* 14 *s.* 10 *d.* $\frac{1}{2}$

CHAP.

CHAP. VI.

REBATE, *or* DISCOUNT.

IS the abating so much Money on a Debt paid before 'tis due, as might be gain'd again by the Money receiv'd, if put out to Interest at the same Rate, and for the same Time. So 100*l.* present Money, would discharge a Debt of 106*l.* due at a Year to come; Rebate being made at 6*l. per Cent.* because 100*l.* put out to Interest for a Year, at the said Rate, would regain the 6*l.*

To work Sums in this RULE.

First find the Interest of 100*l.* for the Time; then by a *Rule of Three* stating, of which the first Number must be 100*l.* with the Interest found; the second Number the Interest alone; (or 100*l.* alone, if you would find the present Money) and the third, the Debt, or Sum propounded, you will find the Answer.

Example.

Examples.

Ex. 1. What's the Rebate of 420 *l.* for a Year, at 6 *l.* *per Cent. per Annum?*

l. *l.* *l.*

If 106 —— 6 —— 420

6

—— *l.*

106)2520(23

212

400

318

82

20

—— *s.*

106)1640(15

106

580

530

50

12

—— *d.*

106)600(5

530

70

4

106)280(2

212

68

Answ. 23 *l.* 15 *s.* 5 *d.* $\frac{1}{2}$

Ex. 2. What present Money will discharge a Debt of 732 *l.* due at 3 Months Rebate, being made at 6 *l. per Cent. per Annum?*

l. *l.*
6 Interest for a Year of 100
Months—
3 $\frac{1}{4}$ 1 10

l. *s.* *l.* *l.*
Then, if 101 10 fall to 100, what will 732
2 2

203 203)146400(721
1421
430
406
240
203
37
20
203)740(3
609
131
12
203)1572(7
1421
151
4
203)604(2
406
198

Ex. 3.

Ans. 721 *l.* 3 *s.* 7 *d.* $\frac{1}{2}$

Ex. 3. What Rebate muſt be allow'd on a Bill of Exchange for 85 *l.* 10 *s.* due *September* the 8th, this being *July* the 4th, Rebate being made at 5 *l. per Cent. per Annum?*

		Days.	*l.*	*Days.*
		If 365	5	66
July	27			5
Aug.	31			
Sept.	8			330
				20
	66			*s. d.*
				365)6600(18 0 $\frac{3}{4}$
				365
				2950
				2920
				30
				12
				360
				4
				365)1440(3
				1095
				345

Then

	l.	*s.*	*d.*		*s.*	*d.*		*l.*	*s.*
Then, if	100	18	0 ¾	——	18	0 ¾	——	85	10
	20				12			20	
	2018				216			1710	
	12				4			12	
	24216				867			20520	
	4							4	
	96867							82080	
								867	
								574560	
								492480	
								656640	
									4
								96867)71163360 (734(	
								678069	
								12(183(3	
								335646	
								290601	15*s.* 3*d.* ¾
								450450	
Answer, 15*s.* 3*d.* ¾								387468	
								62982	

Ex. 4. A Bill of Exchange for 250*l.* is dated at *Amsterdam*, *June* the 13th New Stile; at Usance is accepted, and Payment offer'd the 15th ditto Old Stile, what must be then receiv'd, Rebate being made at 6*l.* *per Cent. per Annum?*

Note. New Stile is 11 Days before Old Stile.

Usance signifies a Month, double Usance, two Months, &c. Note also, Merchants of *London* generally allow 3 Days beyond the Time appointed, calling them 3 Days of Grace. Therefore the Bill being dated *June* the 13th, *N. S.* or the 2d, *O. S.* and accepted at

Uſance, or a Month; it becomes due *July* the 2d, *O. S.* but 3 Days of Grace being allow'd, makes it the 6th. So if the Money is paid the 15th of *June*, *O. S.* Rebate muſt be made for 21 Days. Then,

Days.	*l.*	*Days.*
If 365	6	21

6

126

20

s.

365)2520(6

2190

330

12

d.

365)3960(10

365

310

4

365)1240(3

1095

145

Facit 6 *s.* 10 *d.* $\frac{3}{4}$

l.	s.	d.		l.		l.
If 100	6	10	¾	——— 100	———	250
	20					20
	2006					5000
	12					12
	24080					60000
	4					4
	96323					l.

96323)24000000(249
192646
473540
385292
882480
866907
15573
20
96323)311460(3
288969
22491
12
Answer, 249 l. 3 s. 2 d. ½ d.
96323)269892(2
192646
77246
4
96323)308984(3
288969
20015

More Examples.

What's the Rebate of 100*l.* for ½ a Year at 6*l.* per Cent. *per Annum*?

Answer, 2*l.* 18*s.* 3*d.*

What's the Rebate of 538*l.* 10*s.* for 5 Months, at 5*l.* per Cent. *per Annum*?

Answer, 10*l.* 19*s.* 9*d.* ½

What present Money is a Debt of 629*l.* due at 3 Weeks worth, Rebate being made after the Rate of 6*l.* 10*s.* per Cent. *per Annum*?

Answer, 626*l.* 13*s.*

What present Money will discharge 10000*l.* due at 5 Days, Rebate being made at 8*l.* per Cent. *per Annum*?

Answer, 9989*l.* 1*s.* 5*d.* ¼

CHAP

CHAP. VII.

EQUATION *of* PAYMENTS.

THE Design of this Rule is, when several Sums are due at several Times, to find a mean Time for paying the whole Debt.

The common Way to do which is,

Multiply each Sum by its respective Time, and add all the Products together, dividing their Total by the whole Debt; the Quotient is the mean Time of paying the whole Debt.

Example.

A. owes to *B.* 40*l.* to pay at 2 Months, 60 at 5 Months, and 100*l.* at 10 Months; at what Time may the whole Debt be paid together, without Injury to either?

l.	*l.*	*l*	*l.*
40	40	60	100
60	2	5	10
100			
200	120	300	1000
			300
			120

200)1420(

Answer, 7 Months.

Note, The Times of Payment, if not ſo given, muſt be reduc'd into one Name.

But thoſe who are more exact, take the Pains to work theſe Sums by the following Rule.

Firſt they find the preſent Worth of every particular Sum, then find in what Time to come the Sum of theſe preſent Worths will be increas'd to the Total of all the particular Sums payable at the ſeveral Times to come, and that is the true equated Time for Payment of the Whole.

CHAP.

CHAP. VIII.

FELLOWSHIP, *or* COMPANY,

IS when two, or more, join their Stocks, and trade together, dividing their Gain, or Loss, proportionably.

Fellowship

Is either with or without Time.

Questions without Time, are work'd by this Proportion.

As the whole Stock to the whole Gain or Loss; so is each Man's particular Stock, to his particular Share.

Example.

A. B. and *C.* make a Joint-Stock, *A.* puts in 460*l.* *B.* 510*l.* and *C.* 480*l.* they gain 340*l.* what Part of it belongs to each?

	l.
A.	460
B.	510
C.	480
Total Stock	1450

Then,

Then, if 145|0 —— 340 —— 46 ⊙

l. l. l.

46

2040
1360

l.

145)15640(107
145

1140
1015

125
20

s.

145)2500(17
145

1050
1015

35
12

d.

145)420(2
290

130
4

145)520(3
435

85

l. l. l.
If 145 lo ——— 340 ——— 51 lo

51

340
1700
——— l.
145)17340(119
145
284
145
1390
1305
85
20
——— s.
145)1700(11
145
250
145
105
12
——— d.
145)1260(8
1160
100
4
145)400(2
290
110

And

And, if 145|0——340——48|0

48

2720
1360

l.
145)16320(112
145

182
145

370
290

80
20

l.
145)1600(11
145

150
145

5
12

60
4

145)240(1
145

95

	l.	*s.*	*d.*		*Remainders.*
A's Share is	107	17	2	¼	85
B's Share is	119	11	8	½	110
C's Share is	112	11	0	¼	95
The whole Gain	340	00	0		145)290(2
					290

And thus are these Sums prov'd.

More Examples.

Three Persons make a Joint-Stock; *A.* puts in 565 *l.* *B.* 278 *l.* and *C.* 629 *l.* they gain 1000 *l.* what is each of their Shares?

		l.	*s.*	*d.*		*Remainders.*
Answer,	*A.*	383	16	7	½	384
	B.	188	17	2		512
	C.	427	06	2	½	576

D. E. and *F.* trade together; *D.* puts in 250 *l.* *E.* 129 *l.* and *F.* 344 *l.* 10 *s.* their whole Gain amounts to 529 *l.* what is that to each?

		l.	*s.*	*d.*		*Remainders.*
Answer,	*D.*	108	7	7	½	271
	E.	249	5	7		844
	F.	162	6	9		1092

A. B. and *C.* make a Bank of 3256 *l.* whereof *A.* puts in 1026 *l.* *B.* 985 *l.* and *C.* the rest: by Misfortune they lose 2000 *l.* what Part of it must each bear?

		l.	*s.*	*d.*		*Remainders.*
Answer,	*A.*	630	4	5		528
	B.	605	0	8	½	1240
	C.	764	14	10		1088

Fellowship

Fellowship with Time,

IS thus work'd: Multiply each Man's Stock by the reſpective Time he puts it in for, and add all the Products, the Total of which muſt be your firſt Number through all the Statings; the Gain, or Loſs, the ſecond (as before); and each Man's particular Stock multiply'd by its Time, the third.

Note, All the particular Times (if not ſo given) muſt be reduc'd into one Name, (*i. e.*) all Years, all Months, all Weeks, or all Days, &c.

Example.

A. put into Company 560*l.* for 8 Months, *B.* 279*l.* for 10 Months, and *C.* 735*l.* for 6 Months; they gain'd 1000*l.* what Share of it muſt each have?

l.	*l.*	*l.*
560	279	735
8	10	6
A. ———	*B.* ———	*C.* ———
4480	2790	4410
		2790
		4480
		———
		11680

The

l. *l.* *l.*

Then, if 1168|0 ——— 1000 ——— 448|0

1000

1168)448000(383

3504

·9760

9344

·4160

3504

·656

20

1168)13120(11

1168

·1440

1168

·272

12

1168)3264(2

2336

·928

4

1168)3712(3

3504

·208

I.

If 1168/0 ——— 1000 ——— 279/0

1000

1168)279000(238
2336
4540
3504
10360
9344
1016
20
1168)20320(17
1168
8640
8176
464
12
1168)5568(4
4672
896
4
1168)3584(3
3504
80

And if 1168|0 ——— 1000 ——— 441|0

1000

——— l.

1168)441000(377

3504

9060

8176

8840

8176

664

20

——— s.

1168)13280(11

1168

1600

1168

432

12

——— d.

1168)5184(4

4672

512

4

1168)2048(1

1168

880

	l.	s.	d.		Rem.
A's Share is	383	11	2	¾	208
B's Share is	238	17	4	¾	88
C's Share is	377	11	4	¼	880
				¼	1168)1168(1
	1000	00	0		0

The whole Gain.

More Examples.

A. B. and C. agreeing to trade together, *A.* puts in 529 *l.* for 4 Months; *B.* 329 *l.* for 7 Months; and *C.* 900 *l.* for 2 Months; by their Trade they gain 540 *l.* what Part of it belongs to each?

		l.	*s.*	*d.*		*Remainders.*
Answer,	*A.*	183	14	8	——	2304
	B.	199	19	5	——	1332
	C.	156	05	10 $\frac{1}{4}$	——	2583

Three Persons make a Joint-Stock; *A.* puts in 400 Pieces of Holland, each containing 96 Yards, at 5 *s.* 6 *d. per* Ell *Flemish*, for 5 Months; *B.* 600 Guineas for 8 Months; and *C.* 1800 *l.* for 4 Months; but at 3 Months End, takes out 800 *l.* they gain in all 1000 *l.* how much is each of their Shares?

		l.	*s.*	*d.*		*Remainders,*
Answer,	*A.*	858	19	1 $\frac{1}{4}$	——	2988
	B.	62	19	1 $\frac{3}{4}$	——	1956
	C.	78	01	8 $\frac{3}{4}$	——	3252

CHAP.

CHAP. IX.

ALLIGATION

IS the compounding many Simples into one Maſs, according to any requir'd Price, or Proportion.

This Rule is uſually divided into two Parts, diſtinguiſh'd by the Names of *Medial* and *Alternate*.

Alligation Medial

ANſwers ſuch Queſtions as having the Quantities and Prices of the ſeveral Simples given, only demand the mean Rate of any particular Part of the Compoſition.

Rule.

As the Sum of all the Simples,
To their total Value:
So is any Quantity of the Mixture,
To the Price thereof.

Examples.

(1ſt.) A Grocer would mix 18 lb of Currants at 5 *d.* *per* lb, and 29 lb at 6 *d.* *per* lb, with 12 lb at 8 *d* *per* lb, at what Rate may he ſell a Pound of the Mixture?

First, place the Quantities and their Values as below.

	lb	d.		s.	d.
	18 at	5 *per* lb	comes to	7	6
	29 at	6	—— to	14	6
	12 at	8	—— to	8	0
Sum of all the Sim.	59		*l.*	1 10	0 Total Value.

Then, if 59 comes to 1 10 what will 1 lb

20

30

12

d.

59)360(6 *Answer.*

354

6

Ex. 2. A Grocer would with 12 C. of Sugar, at 3 *l. per* C. mix 3 C. at 50 *s. per* C. and 8 C. at 45 *s. per* C. What will 5 C. of this Mixture be worth?

The Quantities and their Values, plac'd as before, will ſtand thus:

	C.			*l.*	*s.*
	12 at	3 *l. p.* C.	is	36	00
	3 at	50 *s. p.* C.	is	7	10
	8 at	45 *s. p.* C.	is	18	00
Sum of the Simples	23			61	10 Tot. Value.

Then

C. l. s. C.
Then, if 23 —— 61 10 —— 5

20

1230
5

23)6150(267
46 ——
—— 13 l. 7 s. 4 d. ½ facit
155
138
——
170
161
——
9
12
——
23)108(4
92
——
16
4
——
23)64(2
46
——
18

The Proof of this, is as in the *Rule of Three*, only by reversing the Proportion.

So the first Example may be prov'd by this back staring.

lb d. lb
If 1 —— 5 —— 59

And the last by this,

C. l. s. d. C.
If 5 —— 13 7 4 ½ —— 23

remembering in both to take in the Remainders.

More Examples.

If a Vintner mingleth 13 Gallons of Canary, at 6*s.* 8*d.* *per* Gallon, with 20 Gallons of White Wine, at 5*s.* *per* Gallon, and 10 Gallons of Cyder, at 3*s.* *per* Gallon; at what Rate muſt he ſell a Quart of the Mixture?

Anſwer, 1*s.* 3*d.*

If with 40 Buſhels of Corn, at 4*s* *per* Buſhel, there is mix'd 10 Buſhels at 6*s.* *per* Buſhel, 30 Buſhels at 5*s.* *per* Buſhel, and 20 Buſhels at 3*s.* *per* Buſhel; what will 10 Buſhels of the Miſtling be worth?

Anſwer, 2*l.* 3*s.*

Alligation Alternate,

TEacheth what Quantities of ſeveral Simples (whoſe Values are given) muſt be mix'd, that the Compoſition may bear a Price propounded.

This Sort of *Alligation* has three Varieties.

Variety 1.

When the Price of each Simple is expreſs'd, but no Quantity given, and it is requir'd how much of each Simple muſt be mix'd, to ſell any Part of the Compoſition at a mean Price propounded.

In this Variety you have only to link the ſeveral Extreams rightly together, and to find the true Differences betwixt them and the Mean; for thoſe Differences are the Quantities ſought.

Example.

A Vintner would mix four Sorts of Wine of 12*d.* of 18*d.* of 24*d.* and of 26*d.* *per* Quart, what Quantity of each muſt he take, to ſell the Mixture at 20*d.* *per* Quart?

To

To place your Numbers, and link the Extreams, obſerve theſe

Rules.

1ſt. Set down the ſeveral given Prices (which muſt always be of one Name) in a Column, one under another; then, towards your left Hand, draw a Line of Connection; and on the other Side of the ſaid Line, place the mean Rate.

Thus then will ſtand the Numbers of the given

Example.

20 { 12, 18, 24, 26

2*d.* Link them two and two together, always obſerving to join a Greater and a Leſs than the Mean; and againſt each Extream place the Difference betwixt the Mean and its Yoke-Fellow:

Thus,

20 { 12 — 4, 18 — 6, 24 — 8, 26 — 2

Thus the Difference betwixt the Extream 12, and 20 the Mean, being 8, is plac'd againſt 24 its Yoke-Fellow; and between 18 and 20 being 2, is plac'd againſt 26: So alſo the Difference betwixt 24 and 20 being 4, is plac'd againſt 12; and 6, the Difference betwixt 26 and 20, is ſet againſt 18.

So that if he mixes 4 Quarts at 12*d.* 6 at 18*d.* 8 at 24*d.* and 2 at 26*d. per* Quart, he may ſell the Mixture at 20*d. per* Quart.

The Proof of which is eaſy. For the Sum of the Differences valu'd at the mean Rate, will be found equal to the Amount of the particular Differences at their given Prices.

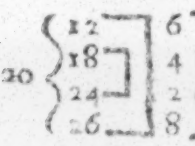
For

For 20 Quarts, the Sum of the Differences at 20*d.* *per* Quart, is 400 Pence; and 4 . 6 . 8 . 2 Quarts, the particular Differences, at 12, 18, 24, 26 Pence *per* Quart, will come to the ſame Sum.

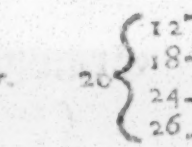
But note, as many different Ways as the Extreams may be combin'd, ſo many different Anſwers may be given to the Queſtion, yet all true.

So the ſame Example being combin'd

thus:



thus:



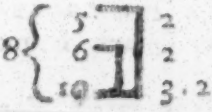
gives thoſe different, but true Anſwers, as may be prov'd by the ſame Rule.

In the laſt of theſe Examples the Numbers being doubly combin'd, (i. *e.*) each with two others, make each have two Differences ſet againſt it; for 12 the firſt Extream, being link'd both with 24 and 26, muſt have both their Differences, *viz.* 4 and 6, plac'd againſt it; and ſo the reſt. Which double Difference muſt be added, and plac'd as above.

But when in a Queſtion there is but one Extream leſs, or but one greater than the Mean; ſuch a Queſtion will admit but of one Anſwer; that ſingle Extream being to be link'd with all the reſt.

Example.

A Grocer would mix Sugars, at 5*d.* 6*d.* and 10*d.* *per* lb. ſo as to ſell the Compound at 8*d.* *per* lb; what Quantity of each muſt he take?



The Numbers being plac'd, link'd, and difference'd, (as above) according to the foregoing Rules, it appears that to sell his Sugar at 8 *d. per* lb, he must mix 2 lb at 5 *d.* 2 lb at 6 *d.* and 5 lb at 10 *d. per* lb.

More Examples.

A Tobacconist would mix Tobacco of 2 *s.* 2 *s.* 6 *d.* and 1 *s.* 3 *d. per* lb, so as to sell the Compound at 1 *s.* 8 *d. per* lb, what Quantity of each must he take?

	lb		*s. d.*	
Answer,	7	at	2 0	*per* lb
	4	at	1 6	
	4	at	1 3	

Several Sorts of Tea, *viz.* of 13 *s.* 18 *s.* 26 *s.* and 30 *s. per* lb, are to be so mix'd, that the Compound may be worth 22 *s. per* lb, what Quantity of each must these be?

	lb		*s.*	
Answer,	8	at	13	*per* lb
	4	at	18	
	4	at	26	
	9	at	30	

Variety 2.

Here we have the Price of all the Simples, and the Quantity of one given, to find the several Quantities of the rest: So that one Measure, or Quantity, may be sold at a mean Rate propounded.

When the Numbers have been set down, and their several Differences found by the foregoing Rules, you must proceed by this Proportion,

As the Difference of that Number whose Quantity is given,

To the rest of the Differences one after another:

So the Quantity given,

To the several Quantities sought.

Example.

Example.

A Distiller would with 40 Gallons of *French* Brandy, at 12 *s. per* Gallon, mix *English* Brandy at 7 *s. per* Gallon, and Spirits at 4 *s. per* Gallon; how much of the two last Sorts must he add, to sell the whole at 8 *s. per* Gallon?

Now it is plain, that were there but 5 Gallons of the *French* Brandy, there must also be but 4 Gallons of each of the other Liquors; but since there is to be 40 Gallons of the *French* Brandy, say

As 5 the Difference against its Price,
To 4 the Difference against the Price of the *English* Brandy,
So is 40 the given Quantity of *French*,
To the Quantity of *English* sought,

which, by this Proportion will be found to be 32. Then again,

As the first Difference 5,
To 4, the Difference against the Price of the Spirits,
So 40, the said given Quantity,
To the Quantity of Spirits sought.

Which, because their Differences are alike, will be the same as of the *English* Brandy, viz. 32.

This Variety has the same Proof as the former.

More Examples.

How much Tea at 14 *s. per* lb, and of 18 *s. per* lb, must be mix'd with 8 lb at 24 *s. per* lb, so as to allow the lb at 20 *s*?

Answer, 8 *l.* of each Sort.

I would with 21 lb of Snuff, at 8 *s. per* lb, mix so much of 4 *s. per* lb, and so much of 5 *s. per* lb, that I might

might afford to sell the Mixture at 6 *s.* *per* lb, what Quantity of each must I take?

lb s.

Answer, { 21 at 8 / 14 at 4 / 14 at 5 } *per* lb

Variety 3.

In this Variety, the particular Prices of each Simple being given, as also the mean Rate of the Compound, is it requir'd how much of each Sort must be taken, to make up the Quantity propounded?

Which (after the Work of the first Variety) is perform'd by this Proportion:

As the Sum of the Differences
To the total Quantity:
So each particular Difference
To its particular Quantity.

Example.

A Druggist hath four Sorts of Green Tea, at 5 *s.* 6 *s.* 8 *s.* and 9 *s.* *per* lb, and would make up a Quantity of 87 lb to sell at 7 *s.* *per* lb, how much of each must he take? See the Work.

lb s.

5 / 6 / 8 / 9 — 2—29 at 5 *per* lb; 1—14 ½ at 6 *per* lb; 1—14 ½ at 8 *per* lb; 2—29 at 9 *per* lb

6

lb lb lb

If 6 — 87 — 2

2

— lb

6)174(29

0

lb lb lb

If 6 — 87 — 1

1

— lb

6)87(14 ½

3

More Examples.

A Vintner hath three Sorts of Wine, of 6*s*. 8*s*. and 10*s*. *per* Gallon, of all which he would compose a Quantity of 120 Gallons, to sell at 7*s*. *per* Gallon, what Quantity muſt there be of each?

	Gall.		*s.*	
Anſwer,	80	at	6	} *per* Gallon.
	20	at	8	
	20	at	10	

A Grocer having Sugars of 5*d*. 6*d*. 8*d*. 10*d*. and 11*d*. *per* lb, would make a Mixture of 3 C. wt. to ſell at 7*d*. *per* lb, how much of each muſt he take?

	lb		*d.*	
Anſwer,	140	at	5	} *per* lb
	84	at	6	
	28	at	8	
	28	at	10	
	56	at	11	

CHAP.

CHAP. X.

The Rule of FALSE, *or* POSITION,

IS not ſo call'd becauſe it is really erroneous, but only becauſe that by the Help of falſe ſuppos'd Numbers, we find the Truth.

This Rule is uſually divided into two Parts, *Single*, and *Double*.

Single Poſition.

IN this Part we make but one Suppoſition, with which working as with a true Number, we regulate the Reſult by this Proportion, *viz.*

As the Total ariſing from the Error,
To the true Total:
So the ſuppos'd Part,
To the true One.

Examples.

1*ſt*. *A*. *B*. and *C*. deſigning to buy a Quantity of Lead, to the Value of 140*l*. agree that *B*. ſhall pay as much again as *A*. and *C*. as much again as *B*. what then muſt each pay?

Now, ſuppoſing *A*. to pay 10*l*. then *B*. muſt pay 20*l*. and *C*. 40*l*. the Total of which is 70*l*. but ſhould be 140*l*. therefore,

If 70*l*. ſhould be 140*l*. what ſhould 10*l*. be

l.

Anſwer 20 for *A*'s Share,
which doubled, makes 40 for *B*'s Share,
and that again doubled, gives 80 for *C*'s Share.

The Total of which is 140 as it ſhould be.

2*d*. Suppoſe the Sum of 20*l*. were to be paid by *A*. *B*. and *C*. thus, *A*. $\frac{1}{2}$, *B*. $\frac{1}{3}$, *C*. $\frac{1}{4}$, what muſt each pay according to that Proportion?

	l.	*l*.	*s*.	*d*.
Firſt, the $\frac{1}{2}$ of 20 being		10	0	0
the $\frac{1}{3}$ —— ——		6	13	4
and the $\frac{1}{4}$ —— ——		5	0	0

The Total will be 21 13 4
but ſhould have been but 20*l*. therefore the Parts found muſt be thus regulated:

l.	*s*.	*d*.		*l*.	*s*.	*d*.		*l*.	*s*.	*d*.
If 21	13	4 fall to	20,	10	0	0	Anſwer.	9	4	7
what will ——				6	13	4		6	3	0
				5	0	0		4	12	5

which, with the Addition of $\frac{1}{2}$ makes juſt 20 0 0

found by dividing the total of the Remainders, —— { 28, 36, 40 }

by the common Diviſor 52)104(2

0

More Examples.

A Gentleman bought a Chaiſe, Horſe, and Harneſs for 50 *l.* the Horſe came to twice the Price of the Harneſs, and the Chaiſe to twice as much as both Horſe and Harneſs, what did he give for each?

		l.	*s.*	*d.*	*Remainders.*
Anſwer.	the Harneſs	5	11	1 ¼	——— 15
	the Horſe	11	2	2 ½	——— 30
	the Chaiſe	33	6	8	———

A. B. and *C.* diſputing of their Age, *A.* affirms he is as old as *B.* and ½ as old as *C.* and *B.* ſays, that he is ⅔ as old as *C.* upon which *C.* ſays, he is ſure both their Ages, added to his, will make 110 Years. I demand the Age of each?

Anſwer. *A.* 45 ½
B. 27 ⅓
C. 36 ⅔

Double Poſition.

IN this Part two Suppoſitions are requir'd, which (if both prove falſe) are, with their Errors, to be thus diſpos'd.

Set down both your Suppoſitions, and againſt each of them their reſpective Errors, mark'd thus +, if too much; or thus —, if too little.

Then multiplying them croſs ways, that is, the firſt Suppoſition by the ſecond Error, and the ſecond Suppoſition by the firſt Error; if both the Errors are alike, (*i. e.*) both too little, or both too much, ſubſtract the leſſer Product from the greater, and divide the Remainder by the Difference of the Errors. But if the Errors are unlike, *i. e.* one too little, and the other too much, the Sum of theſe Products muſt be divided

by the Sum of the Errors: The Quotient will give the true Number, exactly answering all the Demands of the Question.

Or the Suppositions and their Errors, being plac'd as before, work by this Proportion, as a general Rule, viz.

As the Difference of the Errors, if alike,
Or their Sum, if unlike,
To the Difference of the Suppositions:
So either Error to a fourth Number,

which accordingly added to, or subtracted from, the Supposition against it, will answer the Question.

Examples.

1*st*. *A*. *B*. and *C*. playing at Cards, the Money stak'd was 324 Crowns; but disagreeing, each seiz'd as many as he could; *A*. got a certain Number, *B*. as many as *A*. and 15 over; *C*. got a fifth Part of both their Sums added together, how many had each?

First, suppose *A*. got 50
then *B*'s Share will be 65
and *C*'s ——— 23

All which added, make but 138 which is 186 too few.

Then, supposing again that *A*. got 80
B's Share will be 95
And *C*'s ——— 35

The Total of which is still but 210, too few by 114.

Therefore, setting down the Suppositions, and their Errors (mark'd as before directed) against them, they will stand thus:

Suppositions.	*Errors.*
50	186
80	114

then

then multiply'd croſs-ways, the Products will be 14880, and 5700; the leſſer of which (the Errors being alike, *i. e.* both too little) being taken from the greater, there will remain 9180 for a Dividend, which divided by 72, the Difference of the two Errors, quotes 127 ½, the true Number of Crowns *A.* took up; as will appear, by adding 15 to them for *B*'s Share, and dividing the Sum of *A*'s and *B*'s for *C*'s Share; for ſo their particular Numbers will be found to be as follows:

A's ——— 127 ½
B's ——— 142 ½
C's ——— 54

The Total of which is 324, the Numb. of Crowns given.

Or by the other Rule,

As 72, the Difference of the Errors, (becauſe alike) to 30, the Difference of the Suppoſitions:

So is { 186 or 114 } to { 77 ½ or 47 ½ } which added to { 50 or 80 } gives 127 ½ as before.

Example 2.

When firſt the Marriage-Knot was ty'd
Betwixt my Wife and me;
My Age did hers as far exceed,
As three times three does three.
But after ten and half ten Years,
We Man and Wife had been;
Her Age came up as near to mine,
As eight is to ſixteen.
——— Now, pray,
What were our Ages on our Wedding-Day?

First

First, ſuppoſe her 21 then he muſt be 63
then adding to each 15 ——— 15

her Age becomes 36 his 78

This Error therefore is 3 Years too few.

But ſuppoſing her 9, the Error will prove 3 too many.

Setting down therefore againſt the Suppoſitions, the Errors, with their reſpective Marks, they will ſtand thus:

Suppoſitions.		*Errors.*
21	—	3
9	+	3

Then multiplying croſs-ways, 3 times 21 is 63
and 3 times 9 is 27

Theſe Products (becauſe unlike) added, make 90 for a Dividend, which divided by 6, the Sum of the Errors quotes 15, her true Age, prov'd thus:

She being 15, he muſt be ——— 45
15 Years added to each 15

Makes hers 30, juſt half of his —— 60

Or, by the other Rule,

As 6, the Sum of the Errors, (becauſe unlike) to 12, the Difference of the Suppoſitions:

So is the common Error, 3 to 6, which either ſubſtracted from 21, or added to 9, gives 15 (as before) for her Age.

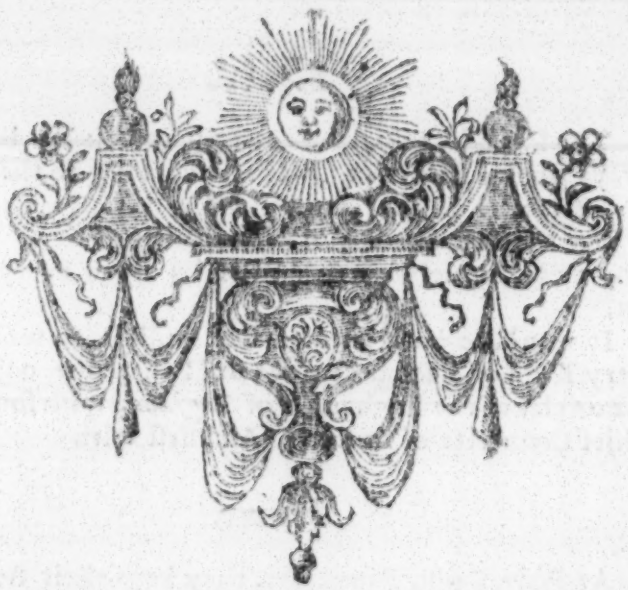
More Examples.

What Number is that, to which if you add ¼ of it ſelf, and from the Sum ſubſtract ⅓ of its ſelf, the Remainder will be 210 ?

Anſwer, 192

A Gentleman caught a Fiſh, whoſe Head was 6 Inches long, the Tail as long as the Head, and half as long as the Body, the Body was juſt the Length of Head and Tail, I demand the Length of the Fiſh ?

Anſwer, 48 Inches, or 4 Feet.



CHAP.

CHAP. XI.

EXCHANGE

IS the receiving Money in one Country, for the Value paid in another.

Note.

The Par of Exchange is certain and fix'd, being always *par pro pari*, *like for like*, according to the Weight and Fineneſs of the Coin.

But the Courſe, or current running Price, between any two Countries, riſes and falls upon every Occaſion.

It would be both needleſs and endleſs to write of every Kind of Exchange; we ſhall therefore only give Examples of the Exchanges of *England*, with ſome other chief Countries of *Europe*. And firſt with

France.

At *Paris*, *Lyons*, *Rouen*, *&c.* they keep their Accompts in Livres, Solzs, and Deniers; and Exchange upon the Crown, the Par of which in Sterling Money, is 4*s.* 6*d.*

Note.

Note.

12 Deniers, 20 Solz, 3 Livres } make { 1 Solz, 1 Livre, 1 Crown

French Money is chang'd into Sterling by this Proportion.

As 1 Crown to the given Rate:
So is the given *French* Sum to the Sterling fought.

Or,

By fuppoſing the given *French* Crowns, Goods, and the Rate of Exchange, the Price; ſo caſting up their Value by *Practice*.

Examples.

1*ſt*. What Sterling Money muſt be paid in *London*, to receive in *Paris* 438 Crowns; Exchange at 56 *d*. *per* Crown?

Cr.	*d*.	Cr.
If 1	56	438
		56
		2628
		2190
		12)24528(
		20)2044
		102 *l*. 4 *s*.

Cr.	*d*.	*s*. *d*.
438	at 56	or 4:8 *per* Cr.
	4*s*. $\frac{1}{3}$	87 12
	6*d*. $\frac{1}{8}$	10 19
	2*d*. $\frac{1}{3}$	3 13
		102 4

2*d*. Change

2*d*. Change 537 Crowns, 14 Solz, 10 Deniers, into Sterling Money, Exchange at 52 *d*. $\frac{1}{2}$ *per* Crown.

Cr.	*d.*	*Cr. Solz. De.*
If 1	52 $\frac{1}{2}$	537 14 10
60	2	60
12		
	105	32234
720		12
		386818
		105
		1934090
		3868180
		2

72'0)40615890(56410

360	
461	12)28205(5
432	
295	2|0)235|0
288	
78	
72	
69	
2	
72)138(1	
72	
66	

Cr. Solz. De.	*d.*
537 14 10	at 52
4*s*. $\frac{1}{5}$ 107 8	
4*d*. $\frac{1}{5}$ 8 19	
$\frac{1}{2}$ $\frac{1}{8}$ 1 2 4	$\frac{1}{2}$
Solz. 10 $\frac{1}{5}$	8 $\frac{1}{4}$
2 $\frac{1}{5}$	1 $\frac{3}{4}$
2 $\frac{1}{5}$	1 $\frac{3}{4}$
Deniers 10 $\frac{1}{12}$ *of* 10 *Sols.*	$\frac{1}{4}$
117*l*. 10*s*. 5*d*.	$\frac{1}{4}$

117*l*. 10*s*. 5*d*. $\frac{1}{4}$ *facit.*

Sterling

Sterling Money is chang'd into *French* by this Proportion:

As the Rate of Exchange, to one Crown:
So is the given *English* Sum, to the *French* sought.

For Examples,

Take the Reverse of the former Questions; which will also be their Proof.

1st. How many *French* Crowns must be paid in *Paris*, to receive in *London* 102 *l.* 4*s.* Sterling? Exchange at 56 *d. per* Crown.

d.	*Cr.*	*l.*	*s.*
If 56	1	102	4

20

2044

12

Crowns.

56)24528(438

224

212

168

448

448

0

2*d.* Change 117*l.* 10*s.* 5*d.* ¼ Sterling, into *French* Crowns. Exchange at 52*d.* ½ *per* Crown.

d.	*Crown.*	*l.*	*s.*	*d.*
If 52 ½	1	117	10	5 ¼
4		20		
210		2350		
		12		
		28205		
		4		
		112821	537	14 10

Crowns. Sols. Deniers.

31
60
——*Sols.*
21)306 0(14
21
——
96
84
——
12
12
——
66 the Remainder of the other Sum.
——
21)210(10 *Deniers.*
21
——
00

105
——
78
63
——
152
147
——
51

More Examples.

If I pay in *Paris* 8297 *Crowns*, 13 *Sols*, 08 *Den.* what may draw my Bill for to *London*, when the Exchange is at 54*d.* ¾ *per* Crown?

Answer, 1875*l.* 10*s.* 4*d.* ¼

What Sterling Money is equal to 954 *Crowns*, 52 *Sols*, when the Exchange is at 58*d.* ½ *per Crown*?

Answer, 231*l.* 5*s.* 1*d.* ½

If I pay in *London* 536*l.* what *French* Money shall I receive in *Paris*, Exchange at 57 *d. per* Crown?

Answer, 2256 *Crowns*, 5 *Solz.*

What *French* Money is equal to 1529*l.* 10*s.* Exchange at 53 *d. per* Crown?

Answer, 6893 *Crowns*, 31 *Solz*, 3 *Deniers.*

Secondly, with ITALY.

IN *Genoa*, *Leghorn*, *&c.* they keep their Accompts in Livres, Solz, and Deniers; and Exchange upon the Piece of Eight, or Dollar; the *Par* of which with *London*, is also 4*s.* 6*d.* Sterling.

Note.

At *Genoa* 5 Livres make a Piece of Eight, at *Leghorn* 6. Observe the Rules for exchanging with *France*.

Examples.

How much Sterling shall I receive in *London*, if I pay in *Genoa* 820 Dollars? Exchange at 51 *d. per* Dollar, or Piece of Eight.

Dollar.	*d.*	*Dollars.*		*Dollars.*
If 1	51	820		820 at 51 *d. per* Dollar.
		51		4
		820	*d.*	3280
		4100	3 ¼	205
		12)41820(		3485
		20)3485		174*l.* 5*s.*
		174*l.* 5*s.*		

Or, back again,

If in *London* I pay 174*l.* 5*s.* Sterling, how many Dollars shall I receive in *Genoa*? Exchange at 51*d.* *per* Dollar.

d.	*Dollar.*	*l.*	*s.*
If 51	1	174	5
		20	
		3485	
		12	
		51)41820(820	
		408	
		102	
		102	
		0	

Venice exchanges by the Ducat, the *Par* about 56*d.* ½ Sterling.

Example.

Change 512 Ducats into Sterling-Money, Exchange 55*d.* ½ *per* Ducat.

Duc.	*d.*	*Duc.*		
If 1	55 ½	512	See Abreviations of Multiplication	
2		512	*Ducats.*	*d.*
111		512	512 at 55 ½ *per* Duc.	
		2)56832(	*d.*	4
		12)28416(	6 ½	2048
		2|0)23618	1 ½ ¼	256
		118*l.* 8*s.*		64
				2358
				118*l.* 8*s.*

Thirdly,

Thirdly, with SPAIN.

IN *Madrid, Sevil, &c.* they keep their Accompts in Rials and Mervadies, and Exchange alſo by the Piece of Eight. The *Par* with *London* 4 *s.* 6 *d.*

Note.

372 Mervadies } make { 1 Rial.
8 Rials } { 1 Piece of $\frac{1}{8}$.

This Exchange is alſo caſt up by the foregoing Rules.

Example.

What Sterling Money may I draw for to *London*, if I pay in *Sevil* 4798 Rials, 250 Mervadies? Exchange at 58 *d.* Sterling *per* Piece of $\frac{8}{9}$.

Rials.	*d.*	*Rials. Mer.*
If 8	58	4798 250
372		372
2976		9596
		33591
		14396
		1785106
		58
		14280848
		8925530
		12
2976)1035361		48(34790(
8928		
		210)2891 9(
14256		
11904		144 19 2 $\frac{1}{2}$
23522		
20832		
26894		
26784		
1108		
4		
2976)4432(1		
2976		
1456		

Change

Or, back again,

Change 144 *l.* 19*s.* 2*d.* ¼ Sterling into *Spaniſh* Money. Exchange at 58 *d. per* Piece of $\frac{8}{9}$.

d.	*Rials.*	*l.*	*s.*	*d.*
If 58	8	144	19	2 ¼
4		20		
232		2899		
		12		
		34790		
		4		
		139161		
		8		

232)1113288(4798 *Rials.*
928
1852
1624
2288
2088
2008
1856
1152
372
304
1064
456
1456 Rem. of the other.

232)58000(250 Mervadies.
464
1160
1160
0

More

More Examples.

Change 83927 Rials into Pounds Sterling, Exchange at 54 *d.* ½ per Piece of Eight.

Answer 2382 *l.* 6 *s.* 0 *d.* ½.

If I pay in *London* 5000 *l.* what *Spanish* Money may I draw my Bill for to *Madrid?* Exchange at 57 *d.* ½ per Piece of Eight.

Answer 168052 Rials, 192 Mervadies.

Fourthly, with PORTUGAL.

IN *Lisbon, Oporto, &c.* they keep their Accompts in Rees, and Exchange on the Mill Ree; the *Par* of which is about 6 *s.* 8 *d.* ½ Sterling.

Note.

1000 Rees make 1 Mill-Ree.

To make this Exchange, ſtill obſerve the ſame Rule.

Examples.

Change 48009 Rees into Sterling Money, Exchange at 6 *s.* 5 *d.* per Mill Ree.

M. R.	*s. d.*	*Rees.*
If 1	6 5	48009
1000	12	77
	77	336063
		336063

12

1|000)3696|693)3696(

4

2|0)30|8

2|772 15*l.* 8*s.* 0*d.* ½

Change

Or, back again,

Change 15*l.* 8*s.* 0*d.* ½ Sterling into Rees, Exchange at 6*s.* 5*d.* *per* Mill-Ree.

Rees.	*l.* *s.*
If 6*s.* 5*d.* ——— 1000 ———	15 8 0 ½
12	20
77	308
4	12
308	5696
	4
	14786
	1000

Rees.

Note 772, Rem. of the other String, is here taken in.

308)14786772(48009
1232
2466
2464
2772
2772
0

More Examples.

What Sterling Money is equal to 595677 Rees Exchange, at 6*s.* 7*d.* *per* Mill-Ree?

Answer, 196*l.* 1*s.* 6*d.*

Change 59*l.* 12*s.* into Rees, Exchange at 6*s.* 10*d.* ½ *per* Mill-Ree?

Answer, 173381 Rees.

Fifthly,

Fifthly, with HOLLAND, FLANDERS *and* GERMANY.

I Take these Places together, because their Accompts are kept, and their Exchange with *England* made the same Way.

For not only in *Amsterdam*, but also in *Antwerp* and *Hamborough*, they keep their Accompts in Pounds, Shillings, and Pence *Flemish*; or, Guilders, Stivers, and Pennicks; and exchange with us upon the Pound, giving us for it, when at *Par*, 33*s*. 4*d*. *Flemish*.

Note.

Their Pounds, Shillings, and Pence, are divided as ours, *viz.* their Pound into 20 Shillings, and their Shilling into 12 Pence.

Their other Money is thus divided.

16 Pennicks } make { 1 Stiver.
20 Stivers } make { 1 Guilder.

Note also,

6 Stivers } make { 1 Shilling { *Flemish*
6 Guilders } make { 1 Pound { *Flemish*

Sterling Money is exchang'd into *Flemish* by this Proportion, *viz.*

As 1 *l.* Sterling to the given Rate;
So is the given Sterling to the *Flemish* sought.

Or,

By supposing the given Sterling, Goods, and the given Rate, their Price, casting up their Value by Practice.

Exampl.

Example.

If I pay in *London* 492 *l.* Sterling, what may I draw my Bill for to *Amsterdam*? Exchange at 34 *s.* 5 *d. Flem. per l.* Sterling.

	l.	*s.*	*d.*	*l.*
If 1		34	5	492
		12		413
Or by Practice.		413		1476
	lb	*s.*	*d.*	492
	492 at	34	5 *per l.*	1968
10	246			
4	98	8		12) 203196(
d 4	8	4		
1	2	1		2|0(16931 3(
	846 *l.*	13 *s.*	*facit.*	846 *l.* 13 *s. Flem.*

If you would have the Answer in Guilders and Stivers,

Divide the *Flemish* Pence by 40, (the Number of Pence which make a Guilder) and the Quotient will be Guilders; and if any Thing remains, the half of it will be Stivers, two *Flemish* Pence being one Stiver.

Or,

Multiply the *Flemish* Pounds, Shillings, and Pence by 6, and it will produce Guilders and Stivers; for 6 Guilders make 1 Pound *Flemish*, and 6 Stivers 1 Shilling *Flemish*.

Example.

846 *l.* 13 *s.* the *Facit* of the last Sum.
6

5079 G. 18 S.

Flemish Pence.

4\|0)203196 (36 rem.

5079 Guild. 18 Stivers.

Flemish

Flemiſh Money (whether Pounds, Shillings, &c. or Guilders, Stivers, and Pennies) is exchang'd into Sterling thus.

As the given Rate to 1 Pound Sterling, ſo is the given *Flemiſh* to the Sterling ſought.

Examples.

Change 846 *l.* 13 *s.* *Flemiſh* into Sterling Money, Exchange at 34 *s.* 5 *d.* *Flemiſh per l.* Sterling.

s. *d.* *Flem.*	*l. Ster.*	*l.* *s.* *Flem.*
If 34 5	1	846 13
12		20
413		16933
		12
		413)203196(492 *l. Sterling*
		1652
		3799
		3717
		826
		826
		0

Or,

Change 5079 Guilders, 18 Stivers into Sterling Money, Exchange 34 *s.* 5 *d.* *per l.* Sterling.

s. d. Flem.	*l. Ster*	*Guild. Stiv.*
If 34 5	1	5079 18
12		20
413		101598
		2

413)203196(492 *l. Sterling.*
1652

3799
3717

826
826

0

More Examples.

Change 475 *l.* Sterling, into *Flemish* Money, Exchange at 33 *s. Flemish per l.* Sterling.

Answer, 783 *l.* 15 *s. Flemish.*

What *Flemish* Money is equal to 365 *l.* 12 *s.* Exchange at 36 *s.* 5 *d. per l.* Sterling.

Answer, 665 *l.* 13 *s.* 11 *d. Flem.*

If I pay at *Amsterdam* 5389 *l.* 14 *s. Flemish*, what Sterling Money shall I receive at *London*, Exchange at 32 *s.* 8 *d. Flemish per l.* Sterling?

Answer, 3299 *l.* 16 *s.* 3 *d.* $\frac{3}{4}$ *Flemish.*

Change 572 *l.* 13 *s.* Sterling into Guilders, Stivers, &c. Exchange at 34 *s.* 10 *d. Flemish per l.* Sterling.

Answer, 5984 *Guilders*, 3 *Stivers*, 12 *Pen.*

What may I draw my Bill for to *London*, if I pay in

Antwerp 7256 Guilders, Exchange at 35 *s.* 2 *d.* ½ *per l.* Sterling.

Anſwer, 686 *l.* 19 *s.* 2 *d.* Sterling.

An Explanation of ſome Characters ſometimes us'd for Brevity's Sake.

+ IS the Mark of *Addition*, and ſhews the Numbers it's plac'd between, are to be added together.

— Is the Mark of *Subſtraction*, and ſhews the latter of the Numbers it ſtands between, is to be taken from the former.

X is the Mark of *Multiplication*, and ſhews the Numbers on each Side, are to be multiply'd together.

÷ Is the Mark of *Diviſion*, and plac'd between two Numbers, ſhews the firſt is to be divided by the laſt.

= Is the Mark of Equality, and ſhews the Number or Numbers preceding it, are equal to that which follows it.

V Plac'd before any Figures, ſhews the Square-Root of them is meant. And

*V*c Before a Number, denotes its Cube-Root.

To make all more plain, obſerve,
Thus the Characters are us'd:

*V*c 4096 = 16, *V* 16 = 4, 4 + 2 = 6, 6 — 2 = 4, 4 X 2 = 8, 8 ÷ 2 = 4.

And thus read:

The Cube-Root of 4096 is, or is equal to, 16; the Square-Root of 16, is equal to 4; 4 added to, or more by 2, is equal to 6; and 6, made leſs by 2, is equal to 4; again, 4, multiply'd by 2, is equal to 8; and 8, divided by 2, is equal to 4.

CHAP.

CHAP. XII.

PROGRESSION

BEING a Rule more curious than useful, and requiring more Words for its full Explication, than are consistent with this *Compendium*, I shall only give some (the most necessary) Propositions in both its Parts, Arithmetical and Geometrical; and refer the more inquisitive Reader to Mr. *Oughtred*'s *Clavis Mathematica*, or Mr. *Hill*'s late ingenious Treatise of *Arithmetick*.

Arithmetical Progression,

IS the regular Increase or Decrease of any Rank of Numbers, by the continual Addition or Substraction of some equal Number.

So 1, 4, 7, 10, 13, 16, are in Arithmetical Progression to each other, equally increasing by the continual Addition of 3.

And so also are 84, 82, 80, 78, regularly decreasing by the continual Substraction of 2.

In Progreſſion, *five Things are to be noted.*

Viz.

I. The firſt Term.
II. The laſt Term.
III. The Number of Terms.
IV. The equal Difference.
V. The Sum of all the Terms.

Any three of which being given, the other two may be found; but it would be too tedious to treat of all the Varieties this will admit; the moſt uſeful are as follows.

Propoſition I.

The laſt Term, Number of Terms, and equal Difference, being given to find the firſt Term:
Or the ſecond, third, and fourth given, to find the firſt.

Rule.

Multiply the fourth by the third, and ſubſtract leſs by one, and ſubſtract the Product from the ſecond, the Remainder is the Anſwer.

Example.

A Man takes out of his Pocket, at 6 ſeveral Times, 6 ſeveral Numbers of Shillings, every one exceeding the former by 6, the laſt was 42, what was the firſt? *Anſwer*, 12*s*.

6X5=30, 42—30=12 *Anſwer.*

Propoſition II.

The firſt, third, and fourth given, to find the ſecond.

Rule.

Rule.

From the Product of the fourth, multiply'd by the third, ſubſtract the fourth, the Remainder added to the firſt, gives the ſecond.

Example.

What's the laſt Number of an Arithmetical Progreſſion, beginning at 4, and continuing, by the Increaſe of 12 to 18 Places? *Anſwer*, 208.

12X18=216, 216—12=204, 204+4=208 *Anſwer.*

Propoſition III.

The firſt, ſecond, and fourth given, to find the third.

Rule.

Subſtract the firſt from the ſecond, and divide the Remainder by the fourth, the Quotient, with one added, gives the third.

Example.

A Traveller went 12 Miles the firſt Day, and increas'd every Day's Journey by 4 Miles, 'till at laſt he went 64 Miles in one Day; how many Days did he travel? *Anſwer*, 14 Days.

64—12=52, 52÷4=13, 13+1=14 *Anſwer.*

Propoſition IV.

The firſt, ſecond, and third given, to find the fourth.

Rule.

Subſtract the firſt from the ſecond, and divide the Remainder by the third, made leſs by one, the Quotient gives the fourth.

Example.

The Ages of ſeven Children increaſe by Arithmetick Progreſſion; the youngeſt is 2 Years old, the eldeſt 32, what's the common Difference of their Ages? *Anſwer* 5 Years.

32—2=30, 30÷7—1=5 *Anſwer.*

Propoſition V.

The firſt, ſecond, and third given, to find the fifth.

Rule.

Half the Sum of the firſt and ſecond, multiply'd by the third, produces the fifth.

Example.

12 Perſons give their Charity to a poor Man in Arithmetical Progreſſion; the firſt gave 2 Pence, the laſt 2 Shillings, or 24 Pence; how much did the poor Man get? *Anſwer*, 156 Pence, or 13 Shillings.

2+24=26, 26÷2=13, 13×12=156 *Anſwer.*

Geometrical

Geometrical Progression.

IS the increasing or decreasing of any Rank of Numbers by some equal *Ratio*, that is, by the continual Multiplication or Division of some equal Number.

Thus 2, 4, 8, 16, 32, increase in Geometrical Progression by a double *Ratio*, or continual Multiplication by 2, and 405, 135, 45, 15, 5, decrease after the same Manner by a continual Division by 3, or by a triple *Ratio*.

In Geometrical Progression, the same five Things are to be noted as in Arithmetical Progression.

Viz.

I. The first Term.
II. The last Term.
III. The Number of Terms.
IV. The *Ratio*, or equal Difference.
V. The Sum of all the Terms.

Note, It is sometimes necessary to set over the Terms their Exponents, the more readily to discover their Places.

Thus	0	1	2	3	4	5
	2	4	8	16	32	64

Proposition I.

To find any remote Term of a Geometrical Progression proceeding from Unity, whose *Ratio* or common Difference is known, without producing all the intermediate Terms.

Rule.

Rule.

Find ſome few of the leading Terms, and place over them their Exponents; then multiplying the laſt found Term by its ſelf, it will produce a Term double thereto; which again multiply'd by its ſelf, will produce another double to the laſt: Thus proceed, till either you produce the Term ſought, or one a little ſhort of it; which may be compleated by multiplying it again by that Term, which ſtands under ſuch Exponent as would make up the Number.

Or in other Words, obſerve what Figures of the Exponents found added together, would give the Exponent of the Term wanted, and the Numbers ſtanding under the ſaid Exponents, multiply'd into each other, will produce the Term requir'd.

Example.

One agrees for 14 Oranges, to pay only the Price of the laſt at a Farthing for the firſt, an half Penny the Second, &c. ſtill doubling the Price for the next, what muſt he give?

Here ſetting down only the five firſt Terms, with their Exponents, the fourteenth may thus be found, 5+5+4=14. So the Terms under thoſe Exponents being multiply'd into each other, give the Term anſwering. But as the Exponent 1 ſtands always over the ſecond Term, ſo the Exponent 13 anſwers to the 14th Term; therefore add only 3 to the two 5's; and ſo always that Exponent muſt be taken, which is one ſhort of the Term requir'd, as for 20, 19, for 30, 29, &c. which muſt be carefully noted.

See the Work of the foregoing Example.

Exponents

Exponents.	*Terms.*	
5	32	the 5th multiply'd
5	32	by its self.
3		
	64	
13	96	

gives 1024 the 10th, which
multiply'd by ——8 the 3d Term,

gives 8192 the 14th.

And so many Farthings, or 8 *l.* 10 *s.* 8 *d.* must he give at the Rate agreed.

Proposition II.

To find any remote Term of a Geometrical Progression, not proceeding from Unity, whose *Ratio* and first Term is given, without producing all the intermediate Terms.

Rule.

Set down, as before, some few of the leading Terms, with their Exponents, and multiply also, as in the first Proposition, the Terms under such Exponents, as added would make the Exponent short by one of the Term requir'd; only remember that every Product must here be divided by the first Term.

Example.

A Sum of Money is thus to be divided among 9 Persons, the 1st to have 50 *l.* the 2d 150 *l.* and so on in that Proportion, one three times more than the other, to the last; what will the last have?

Setting

Setting down the five first Terms with their Exponents, thus,

0	1	2	3	4
50	150	450	1350	4050

Multiply the last Term by its self, and divide the Product by 50, the first Term the Quotient will be 328050 the 9th Term requir'd, answering to the 8th Exponent.

Or setting down but the three first Terms, multiply the last by its self, and divide the Product by the first Term, it quotes the 5th; which again multiply'd by its self, and divided by the 1st, will quote the 9th as before. See the Work.

0	1	2
50	150	450

450	4050
450	4050
22500	202500
2800	162000
50)202500(4050	50)16402500(328050

Answer, 328050 *l.* for the 5th Person.

Proposition III.

Having the first Term, the common Excess, and the Number of Places given, to find the total Sum of the whole Progression.

Rule.

Having found the last Term by the foregoing Rules, substract from it the first, and divide the Remainder by the common Excess, made less by one, the Quotient is the Sum of all, except the last, to which, that being also added, gives the Total requir'd.

Note.

Note. If the *Ratio* be double, that is, if the common Excess be 2, the Difference between the least and greatest Term added to the greatest, gives the total Sum. If the *Ratio* be triple, $\frac{1}{2}$ the Difference must be added; if quadruple, $\frac{1}{3}$, *&c.*

Examples.

1*ſt.* A Coffee-Man, upon the ſigning of the laſt Peace, for 50 Guineas down, agreed to pay the firſt Day one Coffee-Berry, the ſecond two, the third four, and ſo on, to double the Quantity every Day, 'till the ſame was proclaim'd. What Number of Berries would it amount to, ſuppoſing the Time 60 Days. And what would their Value be, ſuppoſing 1000 Berries to the Pound, and the ℔ to be ſold at 5 *s.*

See the Work.

Days.

Days.	Berries.
1	1
2	2
3	4
4	8
5	16

16
16
96
16
256
2
512 the 10th Day.
16
3072
512
8192
2
16384 the 15th Day.
16384
65536
131072
49152
98304
16384
268435456
2
536870912 the 30th Day.
536870912
1073741824
536870912
483183820
375809638
429496729
322122547
161061273
268435456
2882303761517711744
2
37646075230342348 the 60th Day.

1000(752921504606846|975 total Number of Berries.

51. ÷ 1882303761517711 l. 10s. their Value at 5s. per lb.

Ex. 2. A Grazier offers 40 Oxen for a Farthing a Head, and treble it throughout. To what Sum will it amount?

See the Work.

Oxen.	*Farthings.*
1	1
2	3
3	9
4	27
5	81
	81
	81
	648
	6561
	3
	19683 10th Ox.
	19683
	59049
	157464
	118098
	19683
	3
	59049 the 20th Ox.

99379467
99379467
695656269
596276802
397517868
894415203
695656269
298138401
894415203
894415203
3
9876278461204089
3
296288353836122267 the 40th Ox.
444432530754184oo Tot. Farth.
Or,
462950552868941. 3s. 4d.

CHAP. XIII.

VULGAR FRACTIONS.

A Fraction is a Part, or Parts, of an Unit, and is written (if Vulgar) with two Figures, with a Line drawn between them, as $\frac{3}{4}$, $\frac{2}{3}$, or $\frac{5}{6}$.

The Figure under the Line is call'd the Denominator, because it shews into what Parts the Unit is broken; and that above, the Numerator, because it tells how many of such Parts are meant by the Fraction. Thus the Fraction $\frac{3}{4}$ shews, that the Unit is divided into 4 Parts, and that 3 of those Parts are thereby expres'd.

Of Vulgar Fractions, *there are four Sorts*, viz.

1st. A *Proper*; whose Numerator is always less than its Denominator, as $\frac{1}{2}$, $\frac{2}{3}$, $\frac{5}{6}$, &c.

2d. An *Improper*; whose Numerator is always equal to or greater than its Denominator, as $\frac{5}{5}$, $\frac{6}{3}$, &c.

3d. A *Compound*, or, *Fraction of a Fraction*; known by the Word *of*, as $\frac{3}{4}$ of $\frac{5}{9}$, &c.

4th. A *Mix'd Fraction*; which is a Fraction join'd with a whole Number, as $5\frac{1}{2}$, $3\frac{2}{7}$, &c.

Before Fractions can be either added or subtracted, they must be reduc'd into one Denomination; and therefore, before we proceed to those Rules, we must learn

Reduction

Reduction of FRACTIONS,

IN which there are seven Varieties.

First, To reduce a whole Number into an *Improper Fraction*, which is done by placing 1 for its Denominator.

Examples.

Reduce 4 to a Fraction, *facit* $\frac{4}{1}$
or 18, ——— *facit* $\frac{18}{1}$

But if you would assign it any other Denominator, multiply the whole Number by the Denominator assign'd, and place the Product for a Numerator over the assign'd Denominator.

Examples.

Reduce 12 to a Fraction, whose Denominator let be 8. $\frac{8}{96}$ *facit* $\frac{96}{8}$

Or if 6 were to be made a Fraction, and its Denominator to be 7, it would become $\frac{42}{7}$.

Second, To reduce a mix'd Fraction into an improper one.

Multiply the whole Number by the Denominator of the Fraction given, and take in the Numerator; the Product place for a new Numerator over the Denominator given.

Examples.

Reduce $5\frac{3}{5}$ to an improper Fraction. *facit* $\frac{28}{5}$

$$\begin{array}{r} 3 \\ \hline 16 \\ \hline 3 \end{array}$$

So $12\frac{1}{2}$, reduc'd to an improper Fraction, will be $\frac{25}{2}$.

Third, To reduce an improper Fraction into its equivalent whole, or mix'd Number.

Rule.

Divide the Numerator by the Denominator, the Quotient gives the whole Number contain'd: But if any thing remains, (as in the 2d Example) it must be plac'd as a new Numerator over the given Denominator.

Examples.

Reduce $\frac{32}{8}$ to its equivalent whole Number.

8)32(4 *facit*

0

Reduce $\frac{45}{6}$ 6)45(7 $\frac{3}{6}$ *facit*.

42

3

Fourth, To reduce a Compound Fraction to a single one.

Rule.

Multiply all the Numerators together for a Numerator, and all the Denominators for a Denominator.

Examples

Examples.

Reduce $\frac{4}{6}$ of $\frac{5}{8}$ of $\frac{7}{9}$ to a ſingle Fraction.

4	5	$\frac{168}{360}$ *facit.*
6	8	
24	40	
7	9	
168	360	

So alſo $\frac{3}{5}$ of $\frac{5}{6}$ is $\frac{15}{30}$.

Fifth, To reduce a Fraction into its loweſt Terms.

Rule.

Divide the Numerator and Denominator by any Figure, ſo that nothing may remain, and the Quotients will be a new Fraction of the ſame Value with that given.

The Rule generally given for finding the greateſt common Meaſure, or Number, to divide your given Fraction by, is this,

Divide the Denominator by the Numerator, and the Numerator by the Remainder, if any. So continuing to make the laſt Diviſor the Dividend, and the Remainder the Diviſor, 'till nothing remains, the laſt Diviſor will be the greateſt common Meaſure, or Number, by which you can divide your Fraction.

Example.

What is the greateſt common Meaſure by which $\frac{208}{684}$ can be divided?

208)684(3
624

60)208(3
180

28)60(2
56

Anſwer 4)28(7
28

0

$\frac{208}{684}$ then being divided by 4, gives $\frac{52}{171}$, which are its loweſt Terms.

But this Way of finding the common Meaſure, is too tedious, often making more Work than it ſaves. Obſerve therefore theſe more practical Directions.

If you cannot at once diſcover the greateſt Number you may divide by, if both your Numerator and Denominator are even Numbers, you may always halve them, and often that Way reduce your Fraction to Advantage.

Thus the Fraction given in the foregoing Example, divided twice by 2, gives, as before, $\frac{52}{171}$.

2 $\frac{208}{684}$ | $\frac{104}{342}$ | $\frac{52}{171}$

and $\frac{192}{576}$ may be reduc'd, by continual halving, to $\frac{3}{9}$.

2 $\frac{192}{576}$ | $\frac{96}{288}$ | $\frac{48}{144}$ | $\frac{24}{72}$ | $\frac{12}{36}$ | $\frac{6}{18}$ | $\frac{3}{9}$

Alſo, when both your Numerator and Denominator have Cyphers on the right Hand, you may abbreviate the Fraction,

Fraction, by ſtriking off an equal Number from both;

thus, $\frac{45}{27}|\frac{00}{00}$ or, $\frac{825}{270}|\frac{00}{00}$

Or, if the right Hand Figures of your Numerator and Denominator, are both Fives, or one a Five and the other a Cypher, (as the Remainder of the laſt Example) you may always divide them by 5;

thus, $\frac{825}{270}$, divided by 5
is $\frac{165}{54}$, equal to $\frac{825}{270}$.

So alſo is $\frac{125}{245}$ reduc'd to $\frac{25}{49}$.

Thus, in the Rule of Three, we abbreviate our Statings by the ſame Rule, and on the ſame Reaſon; for the ſecond and third Numbers multiply'd together, are as a Numerator to the firſt Number, their Denominator.

Sixth, To reduce Fractions of divers Denominations, into one of the ſame Value.

Rule.

Multiply each of the given Numerators into all the given Denominators, except its own, and the ſeveral Products will be ſo many new Numerators, whoſe common Denominator muſt be the Product of all the given Denominators multiply'd together.

Examples.

Reduce $\frac{2}{4}$, $\frac{5}{8}$, and $\frac{6}{7}$ into one Denomination.

To

To do which,

First, The Numerator 3, must be multiply'd by the Denominators 8 and 10, which will produce 140.

Secondly, The Numerator 5, multiply'd by the Denominators 4 and 10, will produce 200.

Thirdly, The Numerator 6, multiply'd by the Denominators 4 and 8, will produce 192.

} New Numerators.

Then the three Denominators 4, 8, and 10, multiply'd together, will give 320 for a common Denominator.

See the Work.

3	5	6	4
8	4	4	8
24	20	24	32
10	10	8	10
240	200	192	320
1st Numer.	2d Numer.	3d Numer.	Denominator.

$\frac{240}{320}$ $\frac{200}{320}$ $\frac{192}{320}$

So $\frac{3}{8}$, $\frac{5}{4}$, $\frac{6}{4}$, and $\frac{4}{8}$, reduc'd into one Denomination, will be $\frac{240}{320}$, $\frac{200}{320}$, $\frac{192}{320}$, $\frac{320}{320}$.

See the Work.

1st Numer.	2d Numer.	3d Numer.	4th Numer.
7	3	4	9
8	10	10	10
40	30	40	90
12	12	8	8
480	360	320	720
15	15	15	12
2400	1800	1600	8640
480	360	320	
7200	5400	4800	

10
8
80
12
960
15
4800
960
14400
Denominator.

Seventh. To value a Fraction, or reduce it to the known Parts of an Integer.

Rule.

Rule.

Multiply the Numerator by the next inferior Denomination, and divide the Product by the Denominator, the Quotient shews the Parts sought, and the Remainder becomes a new Numerator to the given Denominator; which must still be valu'd by the same Rule, proceeding 'till you have brought it into the least known Parts of the Integer.

Examples.

What's the Value of $\frac{13}{49}$ of a Pound Sterling?

13
20
—— *s. d.*
49) 260(5 3 $\frac{14}{49}$ *facit.*
245
—
15
12
—
49) 180(3
147
—
33
4
—
49) 132(2
98
—
34

And by this Rule are Remainders of Statings in the *Rule of Three*, &c. valu'd. See Pag. 23.

For another Example, find what Hundreds, Quarters, and Pounds, are contain'd in $\frac{53}{94}$ of a Ton.

53
20
— — C. qrs lb
94)1060(11 1 2 $\frac{24}{94}$ facit.
94
120
94
26
4
94)104(1
94
10
28
94)280(2
188
92

Addition of FRACTIONS.

WHEN the given Fractions are of one Denomination, all you have to do, is, to add their Numerators together, and to place the Sum for a new Numerator, over the Denominator given; thus, $\frac{1}{8}$, $\frac{1}{8}$, and $\frac{6}{8}$, added together, make $\frac{8}{8}$, or 1 $\frac{2}{8}$.

But when amongst the given Sums, there are either compound Fractions, or single ones of different Denominations,

minations, they must first be prepar'd by Reduction, before they can be added.

Examples.

What's the Sum of $\frac{3}{5}$, $\frac{2}{3}$, and $\frac{4}{7}$?

First, according to the 6th Sort of Reduction, the given Fractions being brought into one Denomination, they will be $\frac{189}{315}$, $\frac{112}{315}$, $\frac{288}{315}$; the Numerators of which being added, the Sum is $\frac{589}{315}$, or $1\frac{274}{315}$.

2*d*. Add $\frac{3}{4}$ of $\frac{1}{8}$, and $\frac{2}{10}$ of $\frac{6}{7}$ and $\frac{5}{8}$ together.

First, reduce the compound Fractions to single ones, by the 4th Rule of Reduction; and instead of $\frac{3}{4}$ of $\frac{1}{8}$, and $\frac{2}{10}$ of $\frac{6}{7}$, you will have $\frac{3}{32}$ and $\frac{12}{70}$, to add to your $\frac{5}{8}$; all which single Fractions being reduc'd, as before, to one Denomination, they will be $\frac{105}{224}$, $\frac{96}{224}$, and $\frac{140}{224}$; which, added, makes $\frac{341}{224}$, or $1\frac{117}{224}$.

3*d*. Add $4\frac{1}{2}$ and $3\frac{1}{4}$ and $\frac{2}{3}$ together.

$\frac{42}{84}$ $\frac{14}{84}$ $\frac{24}{84}$

4 —— 42
3 —— 14
24
80
facit 7 ——
84

More Examples.

Add 8 *l*. $\frac{1}{2}$ and 3 *l*. $\frac{2}{10}$ and $\frac{12}{15}$ together.
Facit 11 *l*. $\frac{14}{15}$.

What's the Sum of $\frac{3}{4}$ of $\frac{7}{8}$, and 4 *l*. $\frac{1}{2}$ and $\frac{19}{20}$?
Answer, 5 *l*. $\frac{19}{160}$.

Subſtraction

Substraction of FRACTIONS,

IS also nothing (after the given Fractions are prepar'd by Reduction) but taking one Numerator from the other.

Examples.

1*st*. From $\frac{3}{4}$ take $\frac{5}{27}$ (16)

prepar'd $\frac{324}{432}$. $\frac{160}{432}$ $\frac{164}{432}$ Remainder.

2*d*. From $5\frac{3}{7}$ take $\frac{9}{10}$.

First, the mix'd Number $5\frac{3}{7}$ being reduc'd to the improper Fraction $\frac{38}{7}$, by the 2d Rule of Reduction, proceed as before.

$\frac{38}{7}$ or $\frac{380}{70}$

From $\frac{38}{7}$ take $\frac{63}{70}$ Rem. $\frac{317}{70}$ or $4\frac{37}{70}$.

More Examples.

From $5l.\ \frac{2}{6}$ take $\frac{2}{3}$ of $\frac{5}{20}$. Rem. $5l.\ \frac{1}{30}$.

From $\frac{1}{2}\frac{9}{0}$ take $\frac{1}{7}$ of $\frac{3}{5}$. Rem. $\frac{3}{4}\frac{5}{0}\frac{9}{0}$.

Multiplication of FRACTIONS.

IF the Numbers given, are whole, or mix'd, they must first be brought into improper Fractions; or if they are compound Fractions, they must be reduc'd

to single ones; but if the Numbers given, are both either proper or improper single Fractions, you have only to multiply the two given Numerators together for a new Numerator, and the given Denominators for a Denominator.

Examples.

1*st*. Multiply $\frac{2}{3}$ by $\frac{3}{4}$ *facit* $\frac{12}{24}$, or, by Abreviation, $\frac{1}{2}$.

2*d*. Multiply $\frac{2}{3}$ by $\frac{4}{5}$ *facit* $\frac{8}{15}$.

3*d*. Multiply 4 by $\frac{3}{5}$. 4 by the first Sort of Reduction, reduc'd to a Fraction, is $\frac{4}{1}$, which multiply'd by $\frac{3}{5}$, makes $\frac{12}{5}$, or $2\frac{2}{5}$.

4*th*. Multiply $7\frac{1}{2}$ by $8\frac{1}{4}$. These mix'd Fractions reduc'd by the 2d Rule of Reduction to improper ones, make $\frac{15}{2}$ and $\frac{33}{4}$, which multiply'd together, make $\frac{495}{8}$, or $65\frac{1}{8}$.

More Examples.

Multiply $9\frac{1}{2}$ by $\frac{2}{3}$, *facit* $3\frac{1}{3}$.

Multiply 3*d*. $\frac{1}{2}$ by 3*d*. $\frac{1}{2}$, *facit* 14*d*. $\frac{1}{4}$.

Division of FRACTIONS.

WHEN you have made the same Preparation of your Numbers as directed in Multiplication, Multiply the Denominator of your Divisor by the Numerator of your Dividend, for a Numerator; and the Denominator of your Dividend, by the Numerator of your Divisor, for a Denominator.

Example.

1*st*. Divide $\frac{3}{5}$ by $\frac{3}{7}$, *facit* $\frac{21}{15}$, or $2\frac{1}{5}$.

2*d*. Divide 7 by $\frac{3}{4}$, prepar'd by the 1st Rule of Reduction, it will be $\frac{7}{1}$ by $\frac{3}{4}$, *facit* $\frac{28}{3}$, or $9\frac{1}{3}$.

3d. Divide $4\frac{1}{16}$ by $2\frac{1}{8}$, reduc'd by the 2d Rule, it is $\frac{65}{16}$ by $\frac{17}{8}$, which, divided, gives $\frac{15}{34}$, or $1\frac{31}{34}$.

4th. Divide $\frac{2}{3}$ of $\frac{1}{2}$ by $\frac{4}{5}$ of $\frac{7}{9}$, reduc'd by the 4th Rule, $\frac{2}{6}$ by $\frac{28}{45}$, *facit* $\frac{15}{28}$.

More Examples.

Divide $\frac{2}{3}$ *by* $\frac{1}{3}$. *Quote* $2\frac{1}{3}$.

Divide $9\frac{1}{2}$ *by* $\frac{1}{3}$ *of* $\frac{1}{4}$. *Quote* $21\frac{1}{2}$.

The DIRECT RULE *of* THREE IN VULGAR FRACTIONS.

AFTER the Numbers are prepar'd by Reduction, is both ſtated and work'd the ſame as in whole Numbers.

Examples.

1ſt. What will $\frac{1}{4}$ a Pound of Snuff coſt, if $22\frac{1}{4}$ lb of the ſame comes to $7\frac{1}{3}$ *l.*?

lb	*l.*	lb
If $22\frac{1}{4}$ coſt	$7\frac{1}{3}$,	what will $\frac{1}{4}$?

Prepar'd by the 2d Rule of Reduction, it will ſtand thus,

If $\frac{89}{4}$ . . $\frac{22}{3}$ . . $\frac{1}{4}$

then the ſecond and third Numbers multiply'd together, produce $\frac{22}{12}$; which divided by $\frac{89}{4}$, gives $\frac{88}{267}$; which, valu'd by the 7th Rule of Reduction, is 3*s.* 3*d.* 2*qu.* $\frac{1}{3}$ $\frac{8}{89}$.

2d. Bought 87 Gallons and an ¼ of Brandy for 40 l. at the ſame Rate, what would ½ a Gallon coſt?

Gall. *l.* *Gall.*
If $87\frac{1}{2}$ coſt 40, what will $\frac{1}{2}$?

prepar'd $\frac{175}{2}$ ——— $\frac{40}{1}$ ——— $\frac{1}{2}$

l. *s.* *d.* *qu.*
then $\frac{40}{1} \times \frac{1}{2} = \frac{40}{2} \cdot \frac{40}{2} \supset \frac{175}{2} = \frac{80}{350} = \frac{8}{35}$, or 4 6 $\frac{3}{7}$

Another Rule.

When your Queſtion is ſtated, and your Numbers prepar'd, multiply the Denominator of the firſt Number by the Numerators of the ſecond and third, and place the Product for a Numerator: Then multiply the Numerator of the firſt Number by the Denominators of the ſecond and third, and place the Product for its Denominator; and the new Fraction ſo found, is the Anſwer of the Queſtion. Take the Stating of the laſt Queſtion for an

Example.

If $\frac{175}{2} \cdot\cdot \frac{40}{1} \cdot\cdot \frac{1}{2}$ *facit* $\frac{80}{350}$.

For 2, the Denominator of the firſt Number, multiply'd by 40 and 1, the Numerators of the ſecond and third Numbers is 80.

And 175, the Numerator of the firſt, multiply'd by 1 and 2, the Denominators of the ſecond and third is 350. Theſe Products plac'd fractionally, make $\frac{80}{350}$ as before.

3d. What will 82 C. of Sugar come to, if $\frac{3}{4}$ of $\frac{2}{3}$ of a C. coſts $\frac{9}{10}$ of a Pound Sterling.

C. *l.* C.
If $\frac{3}{4}$ of $\frac{2}{3}$ coſts $\frac{9}{10}$, what will 82?

$\frac{3}{4}\frac{2}{3} \cdot\cdot \frac{9}{10} \cdot\cdot \frac{82}{1}$

Facit $\frac{2214}{900}$, or 259 *l.* $\frac{1}{5}$.

More Examples.

What will $\frac{1}{4}$ of an Ounce of Snuff coſt, if the ℔ comes to 8 *s.* $\frac{1}{3}$?

Anſwer, 1 *d.* $\frac{10}{19}$.

At 1 *d.* $\frac{1}{2}$ *per* Ounce, what will 5 C. $\frac{1}{2}$ come to?

Anſwer, 61 *l.* 12 *s.*

The Indirect RULE *of* THREE IN VULGAR FRACTIONS.

HERE alſo you have only to obſerve the Directions given in whole Numbers.

Or this Rule.

After the Numbers are ſtated and prepar'd, multiply the Numerators of the firſt and ſecond Numbers, by the Denominator of the third, for a Numerator; and the Denominators of the firſt and ſecond, by the Numerator of the third Number, for a Denominator; and the Fraction ſo found, is the *Anſwer*. See both Ways in the

Example.

How many Yards of Stuff, $\frac{1}{2}$ Yard wide, are equal to 36 Yards $\frac{1}{4}$ of $\frac{1}{4}$ wide.

If $\frac{1}{4}$ —— 36 $\frac{1}{4}$ —— $\frac{1}{2}$

Prepar'd $\frac{1}{4}$: : $\frac{145}{4}$: : $\frac{1}{2}$

Then $\frac{3}{7} \times {}^{145}/_{4} = {}^{435}/_{28}$. ${}^{435}/_{28} \div {}^{1}/_{2} = {}^{870}/_{28}$ or $54\frac{3}{28}$.

So alſo 3, 145, and 2, the Numerators of the firſt and ſecond Numbers, and the Denominator of the third, multiply'd together, is 870.

And 4, 4, and 1, the Denominators of the firſt and ſecond, and Numerator of the third, multiply'd together, produce 16.

Theſe Numbers fractionally plac'd, make ${}^{870}/_{16}$ as before.

More Examples.

If *A* lends *B* 25 *l.* $\frac{1}{3}$ for 6 Months $\frac{1}{2}$, how long may he keep 10 *l.* $\frac{1}{4}$ of *B*'s, to requite himſelf.

Anſwer, 16 Months ${}^{40}/_{63}$.

If *A* keeps 100 *l.* $\frac{1}{2}$ of *B*'s 4 Months $\frac{1}{3}$, what Sum muſt *A* lend *B* for 2 Years $\frac{1}{2}$ to requite him?

Anſwer, 14 Months $\frac{2}{3}\frac{1}{7}$.

The End of the Firſt Part.

ARITHMETICK
IN
EPITOME.

PART II.

CONTAINING
DECIMAL FRACTIONS,
AND
Extraction of the Roots.

Printed in the Year 1715.

Decimal ARITHMETICK.

PART II.

CHAP. I.

THIS Part of Arithmetick is very compendious, and therefore very useful, especially in Calculations of Interest, valuing Annuities, &c. But by Reason some Fractions of Coin, Weight, and Measure, cannot be exactly express'd by Decimal Parts, but that the Numbers will often circulate, it is not always convenient to work with them. Mr. *Cunn* hath indeed, in his late Treatise on Fractions, very curiously shewn how they may be us'd with least Loss; but since such Exactness destroys their Brevity, I cannot but think, in such Cases, Vulgar Fractions preferable.

In Decimal Fractions, the *Integer*, or whole Thing, (whether it be Time, Coin, Weight, or Measure, as one Year, one Pound Sterling, one Pound Weight, &c.) is

is suppos'd to be divided into Tenths, or ten equal Parts; and those Parts again into Tenths, and so on *ad infinitum*.

So that the Denominator of a Decimal Fraction being always known to consist of an Unit, with as many Cyphers as the Numerator hath Places, is seldom set down; the Parts being only distinguish'd from whole Numbers, by a Point, or Comma, prefix'd thus, ,5 stands for $\frac{5}{10}$, ,325 for $\frac{325}{1000}$, ,123 for $\frac{123}{1000}$.

But the different Value of the several Places will more plainly appear from the following

Table.

Whole Numb. Decimal Parts.

6	5	4	3	2	1	2	3	4	5	6	7
&c. O Thousands.	X Thousands.	Thousands.	Hundreds.	Tens.	Units.	Tenths, or Parts of 10	Parts of 100	Parts of 1000	Parts of 10000	Parts of 100000	Parts of 1000000 &c.

from whence it is evident,

1*st*. That as whole Numbers increase by a tenfold Proportion towards the left Hand, from the Unit's Place; so Decimal Parts decrease, in the same Proportion, towards the right.

2*d*. That therefore Cyphers, plac'd before Decimal Parts, decrease their Value, by removing them farther from the Comma, or Unit's Place.

thus, { 0,5, is 5 Parts of Ten, or $\frac{5}{10}$.
0,05 is 5 Parts of an Hundred, or $\frac{5}{100}$.
0,005 is 5 Parts of a Thousand, or $\frac{5}{1000}$.

3*d*. But that Cyphers, after Decimal Parts, alter not their Value, becauſe they do not change their Places.

for 0,5 0,50 0,500, &c. are each but $\frac{5}{10}$ of an Unit, or 1 ; the 5 ſtill keeping its firſt Place.

Theſe Things underſtood, the reſt is eaſy.

Addition of DECIMALS.

HAVING ſet down your propos'd Numbers, Units under Units, Tens under Tens, and Parts under Parts of like Value, add them as if they were all whole Numbers, ſeparating ſo many Decimal Parts in the Total, as were in any of the given Numbers.

Examples.

Add 5,42, and 38,583, and 421,06, and ,8345 together.

Theſe Numbers,	5,42
rightly plac'd,	38,583
will ſtand thus:	421,06
	,8345
Total,	465,8975

What's the Sum of 4,06, and 21,734, and 523,8642 *l.*

	21,734
	4,06
Anſwer,	549,6582 *l.*

SUB-

SUBSTRACTION.

HAVING plac'd the Numbers as directed in Addition, work ſtill as if they were all whole Numbers.

Examples.

	l.	*l.*
From	839,38275	take 10,49561
	10,49561	
	828,88714	Remainder

	Yards.	*Yards.*
Take	23,279	from 451,15842
		23,279
Remains		427,87942

MULTIPLICATION.

HERE the Numbers are to be ſet down, (without Regard to the Value of their Places) and work'd in all Reſpects the ſame as in whole Numbers; only obſerve to ſeparate ſo many Places of Decimal Parts on the right Hand of the Product, as were in both Multiplicand and Multiplier.

Examples.

Examples.

Multiply 2,735641 by ,54382

,54382

5471282
21885128
8206923
10942564
13678205

1,4876962886 2

Multiply 73,82564365
by 8,7434592

14765128730
66443079285
36912821825
29530257460
22147693095
29530257460
51677950555
59060514920

Product 645,49150367514080

A compendious Way to multiply Numbers that have many Decimal Places.

Rule.

Place one of the Numbers just as it is given for a Multiplicand, and under that Decimal Place which you would have be the last in the Product, set the Unit's Place of your other Number; then reversing all the other Figures, multiply with them in their Order, beginning always with that Figure of the Multiplicand, which stands over the Number you work with; having also Respect to the Increase you think would have been brought from the omitted Figures on the right Hand, had they been multiply'd.

To prove the Certainty of the Rule, we will take the same

Examples.

Multiply 2,735641 by ,54382, and produce only four Places of Decimals.

2,735641
28345,0

13678
1094
82
22

1,4876

Note. There being no Units in the Multiplier, its Place is supply'd with a Cypher.

Multiply 73,82564365 by 8,74346925 and produce but three Places of Decimals.

73,82564365
2954347,8

590605
51678
2953
222
29
4

645,491

Note. To multiply any Decimal Number by 10, 100, 1000, &c. is only to remove the Mark of separation so many Places towards the right Hand as there are Cyphers.

This

Thus 8,3564537, multiply'd by { 10, 100, 1000, 10000, } is { 83,564537 / 835,64537 / 8356,4537 / 83564,537, &c.

DIVISION,

BEING also work'd the same as in whole Numbers, the only Difficulty is to value the Quotient; which may be done by either of the following general Rules, viz.

Rule 1.

The first Figure in the Quotient, is always of the same Value with that Figure of the Dividend which answers, or stands over the Place of Units in the Divisor. Or,

Rule 2.

The Quotient must always have so many Decimal Places, as the Dividend has more than the Divisor.

Note, 1*st*. If the Divisor and Dividend have both the same Number of Decimal Parts, (as in the second Example) the Quotient will be all a whole Number.

2*d*. If the Dividend hath not so many Places of Decimals as are in the Divisor, (as in Example the 3d) so many Cyphers must be annex'd to the Dividend, as will make them equal; and the Quotient will then, as before, be all whole Numbers.

3*d*. But if when Division is done, the Quotient has not so many Figures as it should have Places of Decimal Parts, (as in the last Example) so many Cyphers must be prefix'd as there are Places wanting.

Examples.

1ſt. Divide 10,55439 by 4,569

4,569)10,55439(2,31

14163

4569

...

Here, according to the firſt Rule, 4, the Unit's Place of the Diviſor, ſtanding under Units, or the firſt Place of whole Numbers in the Dividend; 2, the firſt Figure plac'd in the Quotient, muſt alſo be made the firſt Place of whole Numbers, by placing the Point of Separation immediately after it.

Or, according to the ſecond Rule, there being five Places of Decimals in the Dividend, and but three in the Diviſor; two Places muſt be ſeparated off in the Quotient, to make up the Number.

Ex. 2d. Divide 85643,825 by 6,321

6,321)85643,825(13549

22433

34708

21037

57485

596

Here 6, the Place of Units in the Diviſor, ſtanding under 8, the fifth Place of whole Numbers in the Dividend, 1, the firſt Figure of the Quotient, muſt alſo ſtand in the ſame Place, which makes all the Quotient whole Numbers.

And

And ſo it muſt alſo be by the ſecond Rule, becauſe the Dividend has no more Places of Decimals than the Diviſor.

Ex. 3. Divide 7382,54 by 6,4352.

6,4352)7382,5400(1147

Here there not being ſo many Places of Decimals in the Dividend, as in the Diviſor, two Cyphers are added to make them even; and being ſo, the Quotient is all a whole Number, as before.

Ex. 4. Divide ,8516438 by 423

423),8516438(,00020133

564

1413

1448

179

In this Example, the Quotient conſiſting but of five Figures, whereas there ſhould, by the Rules, be eight Places of decimal Parts, three Cyphers are prefix'd to make up the Number, as was directed in *Note* the third.

As multiplying by 10, 100, 1000, &c. is only removing the ſeparating Point of the Multiplicand, ſo many Places as there are Cyphers in the Multiplicator; ſo, to divide by 10, 100, 1000, &c. is only removing the Mark of Separation, after the ſame Manner, towards the left Hand.

Thus 8,3564,537 divided by { 10, / 100, / 1000, / 10000, } is { 8356,4537 / 835,64537 / 83,564537 / 8,3564537 }

These Examples being, I hope, sufficient to make Division plain, we will now proceed to *Reduction of Decimals.*

CHAP. II.

Reduction of DECIMALS,

IS of two Sorts, 1*ſt*. To change a Vulgar Fraction to a Decimal. 2*d*. To value a Decimal by the known Parts of an Integer.

1*ſt*. To reduce or change a Vulgar Fraction to a Decimal.

Rule.

Place Cyphers at Pleaſure after the Numerator; and divide by the Denominator.

Examples.

Reduce $\frac{1}{4}$ to a Decimal 4)1,00(,25 *facit.*

What Decimal Parts are equal to $\frac{3}{8}$?

8)3,000(,375 *facit.*

And ſo any Part of Coin, Weight, Meaſure, or Time, &c. may be brought into a Decimal, by firſt reducing it into a Vulgar Fraction, (which is done by placing the known Parts of the Integer as a Denominator under the Parts given) then annexing Cyphers to

Thus 83564,537 divided by { 10, / 100, / 1000, / 10000, } is { 8356,4537 / 835,64537 / 83,564537 / 8,3564537 }

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to the Numerator, and dividing by the Denominator as before directed.

Examples.

What Decimal Parts of a Pound are equal to 16 s.?

i. e. $\frac{16}{20}$ 20)16,00(,80 *facit.*

What's the Decimal of 9 oz. the Integer a ℔ *Troy*?

i. e. $\frac{9}{12}$ 12)9,00(,75 *facit.*

Note. If the given Parts are of several Denominations, they may be reduc'd either by so many distinct Operations as there are different Parts, or by first reducing them into their lowest Denomination, and then one Division will serve. See both Ways in the

Examples.

Reduce 14 s. 9 *d.* $\frac{1}{4}$ into Decimal Parts of a Pound Sterling: By the first Way there will be these three Vulgar Fractions to be chang'd, $\frac{14}{20}$, $\frac{9}{240}$, and $\frac{1}{960}$.

20)14,00(,70	240)9,0000(,0375	,70	
	1800	,0375	
960)3,0000(,0031		,0031	
1200	1200	*facit* ,7406	
240	00		

The

s. d.

The other Way. 14 9 ¼ being reduc'd to Farthings.

12

177

4

will be 711

which divided by its Denominator, 960)711,0000(,7406 is produc'd, as (before.

3900

6000

240

What Decimal Part of a *C.* are equal to 3 *qrs.* 18 lb.

By the first Way:

¼ and $\frac{12}{112}$ 4)3,00(,75 112)18,0000(,1607

,1607

,9107 *facit.*

680

800

16

By the second Way:

qrs. *lb.*

3 18

28

84

112 Denominator 112)102,0000(,9107

1120

800

16

There

There is alſo another Way of reducing Parts of different Denominations, into Decimals of the higheſt Integer; thus,

Rule.

Bring the loweſt Parts into Decimals of the next ſuperior Denomination; and on the right Hand of the Decimal found, place the Parts given of that ſaid next ſuperior Denomination; ſo proceeding, 'till you bring out the Decimal Parts of the higheſt Integer required, by ſtill dividing the Product by the next ſuperior Denominator; for Examples, take thoſe before given.

Reduce 14*s.* 9*d.* ¾ into Decimal Parts of a Pound Sterling.

4	3,
12	9,75
20	14,8125
	,7406

Here the 3 Farthings being divided by 4, gives ,75 which the 9*d.* being prefix'd, it becomes 9,75; which divided again by 12, quotes ,8125; before which the 14*s.* being alſo plac'd, it makes 14,8125; which being laſtly divided by 20, the Quotient ,7406, is the Anſwer.

What Decimal Parts of a C. are equal to 3 2[qr]. 18 lb.

28 { 7	18,
28 { 4	2,5714
4	3,6428
	,8107

Note. Inſtead of dividing by 28, which would be troubleſom, 'tis better to divide by 7 and 4, as in the Example, 4 times 7 being 28.

Thus you ſee how eaſily the Decimals, anſwering to any given Parts of Coin, Weight, Meaſure, *&c.* are found; and after the ſame manner are the following Tables form'd.

But Shillings, Pence, and Farthings, may more readily be reduc'd thus:

Rule.

For the Shillings, (if their Number be even) ſet down their Half in the firſt Place of Decimals, and let the ſecond and third Places be fill'd up with the Farthings contain'd in the remaining Pence and Farthings, always remembering to add one when the Number is, or exceeds 25; but if the Number of Shillings be odd, the ſecond Place of Decimals muſt alſo be increas'd by 5.

Thus the Decimal of 8 *s.* 5 *d.* ½ will be ,422, 4, in the firſt Place of Decimals, ſtanding for 8 *s.* and 22 Farthings being 5 *d.* ½.

Again 8 *s.* 6 *d.* ½ will be ,427
1 being added to 26, the Number of Farthings in 6 ½, becauſe exceeding 25.

But, laſtly, 9 *s.* 6 *d.* ½ will be thus expreſs'd by Decimals, viz. ,477.

5 being added to the ſecond Place, becauſe the Number of Shillings is odd, the Decimal of 1 Shilling being ,05.

The ſecond Sort of Reduction, is to value a Decimal by the known Parts of its Integer; which is thus done:

Rule.

Multiply the Decimal given, by the known Parts of the next inferior Denomination, and ordering the Product

Product as directed in Multiplication, ſtill multiply the remaining Decimals by the known Parts of the next inferior Denomination; thus proceeding 'till you have brought it into the leaſt known Parts of the Integer, the Figures ſtanding on the left of the ſeparating Points, will be the Parts requir'd.

Examples.

Ex. 1. What's the Value of ,7691, the Integer a Pound Sterling. (*i. e.*) What Shillings, Pence, and Farthings, are equal to ,7691 Parts of a Pound Sterling?

,7691 Parts of a Pound
multiply'd by 20 the Shillings in 1 *l.*

produces Shillings, 15,3820 and Parts of a Shill.
which multiply'd by 12 the Pence in 1 Shill.

makes Pence 4,5840 and Parts of a Penny,
which again multiply'd by 4 the Farthings in 1 *d.*

gives Farthings 2,3360 and Parts of a Farth.

So that the Value of ,7691 Decimal Parts of a Pound Sterling, is 15 *s.* 4 *d.* ½.

Ex. 2. What Ounces, Pennyweights, and Grains, are equal to ,84362 Decimal Parts of a Pound *Troy*?

,84362 Parts of a Pound *Troy*.
Multiply'd by 12 the Ounces in 1 Pound.

Gives Ounces 10,12344 and Parts of 1 Ounce.
Multiply'd by 20 the Pennyweights in 1 *oz.*

Gives Pennyweights 2,46880 and Parts of 1 Pennywt.
Multiply'd by 24 the Grains in 1 Pennywt.

187520
93760

Gives Grains 11,25120 and Parts of one Grain.

The Anſwer therefore is 10 *oz.* 2 *dwts.* 11 *grs.*

But the Decimal Parts of a Pound Sterling, may be thus valu'd at Sight.

Rule.

The Figure ſtanding in the firſt Place of Decimals, doubled, gives Shillings; but if the Figure in the 2d Place, is, or exceeds 5, one more muſt be added for their Number; the ſecond Figure (if under 5) or its Exceſs, (if above 5) join'd with the third, are ſo many Farthings; only remember to abate 1 if their Number exceeds 24, or 2, if above 40.

Examples.

Ex. 1. What's the Value of ,375 Parts of a Pound Sterling? *Anſwer*, 7 *s.* 6 *d.*

The 3 doubled is 6 Shillings, to which 1 *s.* being added for the 5, in the ſecond Place, makes it 7 *s.* and 2 remaining, join'd with the 5 in the 3d Place, being accounted 25 Farthings, from which 1 being deducted,

because above 24, there remains 24 Farthings, or 6 Pence.

Ex. 2. What's the Value of ,846 Parts of a Pound?
Answer, 16*s.* 11 *d.*

the 8 doubled, making 16*s.* and 2 abated from the 46 Farthings, leaves 44 Farthings, or 11*d.*

Thus are shewn the Ways both of finding the Decimals answerable to any given Parts of Coin, Weight, Measure, *&c.* Or the Value of any given Decimal in the known Parts of its Integer.

What follows, are TABLES ready calculated by the foregoing Rules, answering to the same Ends.

Decimal Tables of Coin & Weight

Table 1st.

Coin

1 £ster: y^{e} Integer

S	Dec:	S	Dec:
19	,95	9	,45
18	,9	8	,4
17	,85	7	,35
16	,8	6	,3
15	,75	5	,25
14	,7	4	,2
13	,65	3	,15
12	,6	2	,1
11	,55	1	,05
10	,5		

Pence	Decim:
11	,045833
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Farthings	Decim:
3	,003125
2	,002083
1	,001042

Table 2d.

Troy Weight

1 lt. the Integer

Ounces	Decim:
11	,916666
10	,833333
9	,75
8	,666666
7	,583333
6	,5
5	,416666
4	,333333
3	,25
2	,166666
1	,083333

Note. This Table of Oz: will also serve for Inches Months or Doz:

Penny w^{t}	Decim:
10	,041666
9	,0375
8	,033333
7	,029166
6	,025
5	,020833
4	,016666
3	,0125
2	,008333
1	,004166

Grains	Decim:
20	,003472
10	,001736
9	,001561
8	,001389
7	,001216
6	,001042
5	,000868
4	,000694
3	,000521
2	,000347
1	,000173
½	,000086

Table 3d.

Avoirdupoise

1 lt. y^{e} Integer.

Quarters	Decim:
3	,75
2	,5
1	,25

Pounds	Decim:
20	,178571
10	,089286
9	,080357
8	,071428
7	,0625
6	,053571
5	,044643
4	,035714
3	,026786
2	,017857
1	,008928

Ounces.	Decim:
10	,005580
9	,005022
8	,004464
7	,003906
6	,003348
5	,002790
4	,002232
3	,001673
2	,001116
1	,000558

Drams	Decim:
10	,000348
9	,000313
8	,000279
7	,000244
6	,000209
5	,000174
4	,000139
3	,000104
2	,000069
1	,000034
½	,000017

Webster scripsit. Bickham Sculpsit.

Decimal Tables of Measure and Time

Table 4th

Time 1 year y Integer

Days	Decim:
300	,821918
200	,547945
100	,273973
90	,246575
80	,219178
70	,191781
60	,164383
50	,136986
40	,109589
30	,082192
20	,054794
10	,027397
9	,024657
8	,021918
7	,019178
6	,016438
5	,013699
4	,010959
3	,008219
2	,005479
1	,002739

Webster scrip.t

Table 5th

Measure Liquid. Dry Integer 1 Gall: 1 Quarter

Pints	Decim:	Bush.
7	,875	7
6	,75	6
5	,625	5
4	,5	4
3	,375	3
2	,25	2
1	,125	1

qr. Pts	Decim:	Pecks
3	,09375	3
2	,0625	2
1	,03125	1

Decim:	qrs. Pecks
,023437	3
,015625	2
,007812	1

Decim:	Pints
,005859	3
,003906	2
,001953	1

Cloth Measure 1 Yard y Integer

Quartes	Decim:
3	,75
2	,5
1	,25

Nails	Decim:
3	,1875
2	,125
1	,0625

Table 6th

Time 1 Day y Integer

Hours	Decim:
20	,833333
10	,416666
9	,375
8	,333333
7	,291666
6	,25
5	,208333
4	,166666
3	,125
2	,083333
1	,041666

Minutes	Decim:
50	,034722
40	,027777
30	,020833
20	,013888
10	,006944
9	,00625
8	,005555
7	,004861
6	,004166
5	,003472
4	,002777
3	,002083
2	,001388
1	,000694

Bickham Scul.t

SIDE 75

The Uſe of the foregoing Tables, is very plain, one Column in each Table containing the Number of Shillings, Ounces, Drams, Pints, Buſhels, Days, Hours, or any thing elſe you may want. And againſt the ſaid Number, in the other Column, the Decimal Parts anſwering. Thus againſt 3 in the firſt Table, is found ,0125, and againſt 40 Days in the fourth Table, ,109589.

But if the Number you want is not to be found in the ſaid Tables (many compound Numbers having been omitted, to reduce them into ſo narrow a Compaſs) you muſt add the Parts of ſuch two or three Numbers together, as will compoſe it, and the Total will be the Decimal ſought. Thus, if the Decimal of 17 Penny-weights, the Integer a Pound *Troy*, were to be ſought in the 2d Table ,041666 the Decimal of 10 Penny-weights, and ,029166 the Decimal of 7 Penny-weights, being added together, the Total ,070832 will be found the Anſwer; or, if in Table the fourth, you would find the Decimal of 352 Days,

add ,821918 } the { 300 }
,136986 } Decimals { 50 } Days.
,005479 } of { 2 }

give ,964383 anſwering 352

and ſo of any other.

CHAP. III.

The RULE *of* THREE.

THIS Rule having been already ſufficiently explain'd, both as to its Nature and Operation in Vulgar Arithmetick, 'tis needleſs to repeat here what has been there ſaid. Only therefore obſerve, that inſtead of preparing your Numbers, by reducing them into their loweſt Denomination, you muſt now bring their Fractional Parts into Decimals. See the

Examples.

Ex. 1. If the Price of 26 Yards and $\frac{1}{2}$ of Drugget is 3 *l.* 16 *s.* 3 *d.* what will 32 Yards and $\frac{1}{4}$ come to?

The Fractional Parts of the Numbers being reduced to Decimals, and the Queſtion ſtated as uſual, the Work will ſtand as follows:

Yards.

If 26,5 —— 3,8125 —— 32,25

32,25

190625

76250

76250

114375

26,5)122,953125(4,63974

1697

1053

2581

1962

1075

115

The Quotient, valu'd by the ſhort Rule for Money, makes 4*l.* 12*s.* 9*d.* $\frac{1}{2}$

Ex. 2. What will the Pay of 540 Men amount to at 1*l.* 5*s.* 6*d.* *per* Man.

Man. *l.* *Men.*

If 1 —— 1,275 —— 540

540

51000

6375

Anſwer, 688,500 or 688*l.* 10*s.*

For more Examples, take thoſe given in Vulgar Arithmetick.

The Indirect RULE of THREE

IS alſo the ſame here as in Vulgar Arithmetick, differing only in the Preparation of the Numbers.

Example.

What muſt the Penny-Loaf weigh, when Wheat is 20 *s.* the Buſhel, if, when at 6 *s.* 8 *d.* *per* Buſhel, the Penny-Loaf weighs 5 *oz.* ½

If ,33333 —— 5,5 —— ,5

5,5

		oz.	dwts.	grs.
166665	*Anſw.*	3	13	7
166665				

25)1,833315(

3,66663

Fall

Take also one Example in the DOUBLE RULE.

If the Carriage of ¼ a C. wt. 40 Miles, comes to 6 *d.* what will be the Charge of carrying 16 C. ¼ 100 Miles?

First, if ,25 —— ,025 —— 16,25
,025
8125
3250
,25)4,0625(
Miles.
Then if 40 —— ,8125 —— 100
100
40)81,2500(
facit 2,03125
or,
2 *l.* 0 *s.* 7 *d.* ¼

CHAP.

CHAP. IV.

PRACTICE.

SOME Questions in this Rule may also be advantagiously work'd by Decimals, as

1*ſt*, When the given Price is just two Shillings, &c. only ſeparating the right Hand Figure for a Decimal, the reſt are Pounds, ſo in the

Example.

529,5 lb, at 2 *s.* *per* lb, comes to { 529,5 or 529 *l.* 10 *s.*

2*d*. When the Price is any aliquot Part of 2 *s.* &c. only ſeparating the right Hand Figure, as before, and then dividing the Number by ſuch Part.

Example.

oz.		*d.*	
258,3	at	8 *d.*	*per* oz.
		l.	*s.*
8 ½ 86,1 *facit*,		or 86	2

3*d*. Where

3*d*. When the given Price can be divided into aliquot Parts of two Shillings, feparate as before, and take fuch Parts.

Example.

	lb	*d*.
d.	563,8 at 9 *per* lb.	
6 ¼	140,95	
3 ½	70,475	

facit 211,425 or 211 *l*. 8 *s*. 6 *d*.

4*th*. When the Price is any Number of Shillings whatfoever, 'tis only multiplying by their half, (which is the Decimal of them) and the Product is the Anfwer.

Examples.

lb	*s*.		oz.	*s*.
7296	at 12 *per* lb		8264	at 15 *per* oz.
,6			,75	
facit 4377,6	or 4377 *l*. 12 *s*.		41320	
			57848	
			l. 6198,00	*facit*.

5*th*. The requir'd Price of any Quantity may be found, by multiplying the faid Quantity by the Decimal of the Price given.

Example.

Example.

lb *l.* *s.* *d.* *per* lb
8397 at 5 13 6 *per* lb
5,675

41985
58779
50382
41985

facit 47652,975 or 47652 *l.* 19 *s.* 6 *d.*

Note. If there are Fractional Parts in the given Quantity, they must be reduc'd to Decimals, as well as the Fractional Parts of the Price, as in the following

Examples.

lb *s.*
368 ½ at 13 *s.* *per* lb.
368,5
,65

18425
22110

facit 239,525
or,
239 *l.* 10 *s.* 6 *d.*

C. *qrs.* lb *l.* *s.* *d.*
7368 3 14 at 1 13 6

7368,875
1,625

3684437
14737750
44213250
7368875

facit 11974,421875
or,
11974 *l.* 8 *s.* 5 *d.* ½

The Questions propos'd in Vulgar Arithmetick, will here also serve for more Examples.

CHAP.

CHAP. V.

Intereſt and *Rebate.*

THESE Rules having been already ſufficiently explain'd in Vulgar Arithmetick, it only now remains to ſhew how much more advantagiouſly they may be work'd by Decimals. And firſt,

Simple Intereſt.

THE Annual Intereſt of any Sum of Money is found by only multiplying the given Principal by the Intereſt of one Pound for a Year, which

at $\left\{\begin{matrix}4\\5\\6\end{matrix}\right\}$ *per Cent.* is $\left\{\begin{matrix},04\\,05\\,06\end{matrix}\right.$

found by dividing the Rate of Intereſt by 100.

Examples.

Examples.

1*st*. What's a Year's Intereſt of 536 *l*. at 5 *per Cent*.

536 *l*.
,05

facit 26,80 or 26*l*. 16*s*.

2*d*. What will the Intereſt of 2367 *l*. come to in a Year, at 6 *l*. *per Cent. per Annum*?

2367 *l*.
,06

facit 142,02 or 142*l*. 0*s*. 5*d*.

Thus a Year's Intereſt of any Sum being found, 'tis only multiplying that Sum by 2, 3, 4, *&c*. and the Product is the Intereſt of the ſaid Sum for 2, 3, 4 or more Years.

Example.

What is the Intereſt of 623 for 3 Years, at 4 *per Cent*.

623
,04

24,94 Intereſt for 1 Year.
3

74,82 or 74*l*. 16*s*. 5*d*. } Intereſt for 3 Years.

Again, if the Time requir'd, be Months, 'tis only dividing the Year's Amount by ſuch Parts as the given Months are of a Year.

Examples

Examples.

Ex. 1ſt. What is the Intereſt of 539 *l.* for four Months, at 5 *l. per Cent. per Annum*?

l.
539
,05

26,95 Intereſt for a Year.

Months
4 $\frac{1}{3}$ 8,98$\frac{33}{}$
or
8 *l.* 19 *s.* 5 *d.* $\frac{1}{2}$.

Ex. 2d. What will the Intereſt of 729 *l.* 10 *s.* 6 *d.* come to in a Year and five Months, at 6 *per Cent. per Annum*?

Note, If there are any odd Shillings, Pence, and Farthings in the principal Sum, they muſt be reduc'd to Decimals, as in this Example.

l.
729,525
,06

Months		
	43,77150	Intereſt for a Year.
4 $\frac{1}{3}$	14,59050	Intereſt for 4 Months.
1 $\frac{1}{4}$	3,647825	Intereſt for 1 Month.
facit	62,009625	Total Intereſt.

or
62 *l.* 0 *s.* 2 *d.* $\frac{1}{4}$

But if it is requir'd to find the Intereſt of a Sum of Money for any Number of Days, you muſt either multiply the Year's Amount by the Number of Days propos'd, and divide the Product by 365, or (which will be ſometimes ſhorter) divide the Year's Amount

by 365, and multiply the Quotient by the Number of Days propos'd.

Example.

What Intereſt will *l.* 563,06 amount to in 126 Days, at 6 *per Cent. per An.*

33,78 × 126 = 4256,28

4256,28 ÷ 365 = 11,661

33,78 × 126 = 4256,28

365)4256,28(11,661

606

2412

2228

380

15

365)33,78000(,09254

930

2000

1750

290

,09254 × 126 = 11,66004

55524

18508

9254

11,66004

But for the more ready caſting up the Intereſt of Money for Days, it will be neceſſary to have the Intereſt of 1 *l.* for 1 Day, at all Rates ready calculated as a Table or Standard. Thus

The INTEREST *of* 1 *l. for* 1 *Day.*

At	per Cent.	is
1		,00002739726
2		,00005479452
3		,00008219178
4		,00010958904
5		,00013698630
6		,00016438356
7		,00019178082
8		,00021917808
9		,00024657534
10		,00027397260

The Intereſt of 1 *l.* for 1 Day, is thus found; the given Rate or Intereſt of 100 *l.* for a Year, being divided by 100, quotes the Intereſt of 1 *l.* for a Year; which again divided by 365, gives the requir'd Intereſt of 1 *l.* for 1 Day; which, when multiply'd into both the Number of Days, and the principal Sum, produces the Intereſt for the Time requir'd.

Example.

What's the Intereſt of 560 *l.* for 60 Days, at 5 *l.* per Cent. *per Annum*?

,00013698630
560 Principal.

82191780
68493150

76712328000
60 Days.

Facit 4,602739680 or 4*l.* 12*s.* 0*d.* ½.

The Year being divided into 12 unequal Months, the following old Verſes may ſerve as a *Memorandum* of the Number of Days in each, *viz.*

Thirty Days hath September,
April, June, *and* November;
February *hath twenty eight alone,*
All the reſt have thirty one.

But without any farther Trouble, the annexed Table ſhews, by Inſpection only, the Number of Days from any Day in any Month, to the ſame Day in any other Month. As ſuppoſe the Number of Days, betwixt the 4th of *February* and the 4th of *September*, were requir'd, looking in the Column under *February* for *September*, againſt that Month will ſtand 212, the Number of Days betwixt the ſaid Times; ſo again, from the 8th of *June* to the 8th of *October*, appears by the Table to be 122 Days, that being the Number againſt *October*, in the Column under *June*.

Note, If the given Days are different, 'tis only adding, or ſubſtracting their Inequality to, or from the tabular Number. Thus had the firſt Example been from the 4th of *February*, to the 8th of *September*, it had been 4 Days more than 212, *viz.* 216; or had the Time, in the laſt Example, been from the 8th of *June*, to the 4th of *October*, it had been 4 Days leſs than 122, *viz.* 118.

Note alſo, If the Time exceeds a Year, 365 Days muſt be added. Thus from the 4th of *February* 1714, to the 4th of *September* 1715, will be found to be 577 Days, the Sum of 212, and 365. See the Table.

A Table

A Table

Shewing the Number of Days from any day in any Month to the same day in any other Month.

From	Jan:	Feb:	Mar:	April.	May.	June.
To	Feb: 31	Mar 28	April 31	May 30	June 31	July 30
	Mar: 59	April 59	May. 61	June. 61	July 61	Aug: 61
	April 90	May 89	June 92	July. 91	Aug: 92	Sep: 92
	May 120	June 120	July 122	Aug: 122	Sep: 123	Oct: 122
	June 151	July. 150	Aug: 153	Sep: 153	Oct: 153	Nov: 153
	July 181	Aug: 181	Sep: 184	Oct: 183	Nov: 184	Dec: 183
	Aug: 212	Sep: 212	Oct: 214	Nov: 214	Dec: 214	Jan: 214
	Sep: 243	Oct: 242	Nov: 245	Dec: 244	Jan: 245	Feb: 245
	Oct: 273	Nov: 273	Dec: 275	Jan: 275	Feb: 276	Mar: 273
	Nov: 304	Dec: 303	Jan: 306	Feb: 306	Mar: 304	April 304
	Dec: 334	Jan: 334	Feb: 337	Mar: 334	April 335	May 334
	Jan: 365	Feb: 365	Mar: 365	April 365	May 365	June 365

From	July.	Aug:	Sep:	Oct:	Nov:	Dec:
To	Aug: 31	Sep: 31	Oct: 30	Nov 31	Dec: 30	Jan: 31
	Sep: 62	Oct: 61	Nov: 61	Dec: 61	Jan: 61	Feb: 62
	Oct: 92	Nov: 92	Dec: 91	Jan: 92	Feb: 92	Mar: 90
	Nov: 123	Dec: 122	Jan: 122	Feb: 123	Mar: 120	April 121
	Dec: 153	Jan: 153	Feb: 153	Mar: 151	April 151	May 151
	Jan: 184	Feb: 184	Mar: 181	April 182	May 181	June 182
	Feb: 215	Mar: 212	April 211	May 212	June 212	July 212
	Mar: 243	April 243	May 242	June 243	July 242	Aug: 243
	April 274	May 273	June 273	July 273	Aug: 273	Sep: 274
	May 304	June 304	July 303	Aug: 304	Sep: 304	Oct: 304
	June 335	July 334	Aug: 334	Sep: 335	Oct: 334	Nov: 335
	July 365	Aug 365	Sep: 365	Oct: 365	Nov: 365	Dec: 365

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Compound Intereſt.

1*ſt.* TO find the Amount of any Sum, at any Rate of Compound Intereſt, for any Number of Years.

Rule.

Multiply the Rate, that is, the Amount of 1 *l.* for 1 Year (which, at 6 *per Cent.* is 1,06, at 5 *per Cent.* 1,05, *&c.*) ſo often into itſelf, as are the Number of Years propos'd, wanting one; and the laſt Product, multiply'd by the Principal, will give the Amount requir'd.

Example.

What's the Amount of 500 *l.* forborn four Years, at 4 *l. per Cent. per Annum?*

1,04
1,04

1,0816
1,04

1,124864
1,04
500
---
facit 584,92928000

And thus is the firſt Intereſt-Table (which ſhews the Amount of 1 *l.* for any Number of Years, under 33, at the Rates of 5 and 6 *l. per Cent. per Annum*) form'd.

The Uſe of which is plain and eaſy; for multiplying the Figures ſtanding againſt the Number of Years requir'd; and under the given Rate, by the propos'd Principal, the Product is the Amount deſir'd.

Thus if the Amount of 40 *l.* in 20 Years, at 5 *l. per Cent. per Annum*, were requir'd, 2,65329, the tabular Number, multiply'd by 40 *l.* the principal Sum, gives 106,13160, or 106 *l.* 2 *s.* 7 *d.* ½, the *Answer*. And so any other.

2*d.* To find the Amount of any Annuity, or yearly Penſion, forborn any Number of Years whatſoever, at any Rate of Compound Intereſt.

Rule.

Multiply the firſt yearly Payment by the Rate, and to the Product add the ſecond yearly Payment, the Sum is the Amount in 2 Years; which, multiply'd again by the Rate, the Product, with the Addition of the third yearly Payment, is the Amount for 3 Years, &c.

Example.

What will a Penſion of 30 *l. per Annum* amount to, being forborn 4 Years, at 5 *l. per Cent. per Annum*?

	l.
Firſt yearly Payment	30
multiply'd by the Rate	1,05
	31,50
Second yearly Paym. added	30
gives	61,50 the Amount in 2 Years
	1,05
	64,5750
Third yearly Payment	30
	94,5750 Amount in 3 Years
	1,05
	99,303750
Fourth yearly Payment	30
	129,303750 Amount in 4 Years

And after this Manner is the second Interest Table (which shews the Amount of 1 *l.* Annuity for any Number of Years under 33, at the Rates of 5 and 6 *l. per Cent. per Annum*, Compound Interest) compos'd.

But this second Table may more easily be form'd from the first, thus: The first Line of this second Table, or first Year's Amount being known, add to it the first Line of the first Table, the Sum is the Amount for 2 Years, or the second Line of this Table; to which again adding the second Line of the first Table, you have the third of this, or the Amount for three Years, *&c.*

Example *at* 6 *l. per Cent.*

l.		
1,	———	First Year of the second Table.
1,06	———	First Year of the first Table.
2,06	———	Second Year of the second Table.
1,1236	———	Second Year of the first.
3,1836	———	Third Year of the second.
1,19101	———	Third Year of the first
4,37461	———	Fourth Year of the second, *&c.*

The Use of this second Table is in the same Manner as the first, as suppose the foregoing Question for an

Example.

4,310212 { the Amount of 1 *l.* Annuity for 4 Years, at 5 *l. per Cent.*
multiply'd by 30 the Yearly Sum,

gives 129,30360 as before.

REBATE, *or* DISCOMPT.

REBATE, according to Simple Interest, having been sufficiently explain'd in Vulgar Arithmetick, I shall only add here, as a Table, or Standard, the Discompt of 1 *l.* for 1 Day, at all Rates, from 1 to 10 *l. per Cent.* which is found by dividing the Annual Interest of 1 *l.* by 1 *l.* added to its Interest, and that Quotient by 365; thus, at 1 *per Cent.* 1,01 the Interest of 1 *l.* for a Year, divided by 1,01, quotes ,00990099, the Discompt of 1 *l.* for one Year; which again divided by 365, quotes ,00002712 6, the Discompt of 1 *l.* for one Day. So that

The Discompt of 1 *l.* for 1 Day, at	*per Cent.* is
1	,00002712 60
2	,00005372 01
3	,00007979 78
4	,00010537 40
5	,00013046 32
6	,00015507 88
7	,00017923 44
8	,00020294 26
9	,00022621 59
10	,00024906 60

To find the Discompt of any Sum by this Table, multiply the Figures standing against the Rate of Interest propos'd, by the principal Sum, and the Product by the Number of Days requir'd, and you have the Discompt demanded.

Example.

Example.

What Discompt must be allow'd on a Bill of 600 *l.* paid 40 Days before it is due, Rebate being made after the Rate of 6 *l. per Cent. per Annum*?

,0001550788——Discompt of 1 *l.* for 1 Day.
600—Principal

,00,0930472800
40 Days
Anſ. 3,721891 2000 Discompt of 600 *l.* for 40 Days.

REBATE *at Compound Intereſt.*

1ſt. TO find the preſent Worth of any Sum to be paid at any Number of Years to come, Rebate being made at any Rate of Compound Intereſt.

Rule.

Divide the Principal continually ſo many times by the Rate, as are the Number of Years propos'd, and the laſt Quotient is the Anſwer.

Example.

What is the preſent Worth of 1 *l.* to be paid at the End of 6 Years, Rebate at 6 *l. per Cent. per Annum*, Compound Intereſt?

The

	l.				
The Principal 1,		Divi-	,943396	Present Worth under	1
,943396		ded by	,889997		2
,889997		1,06	,839619		3
,839619		the	,792094		4
,792094		Rate,	,747258		5
,747258		gives	,704960		6

And thus is the third Table made, which shews the present Worth of 1 *l.* due at any Number of Years to come, under 33, Rebate at 5 and 6*l. per Cent. per Annum*, Compound Interest; the Use of which is, as the other Tables, only by multiplying the present Worth of 1 *l.* by the given Principal, and the Product is the present Worth requir'd.

Thus suppose in the Example above, the Principal had been 200 *l.* the present Worth of 1 *l. viz.* ,704960 multiply'd by 200, gives 140,992000, the present Worth of 200 *l.* and so any other.

2*d.* To find the present Worth of any Annuity, or yearly Pension, to continue any Number of Years, Rebate being made at any Rate, *per Cent. per Annum*, Compound Interest.

Rule.

Find by the foregoing Rule the present Worth of the propos'd Annuity, for 1, 2, 3, or so many Years as are demanded; and the Sum of those respective present Worths will be the Value of the Annuity; that is, the first and second of those Values, added together, will be the present Worth for two Years; and the first, second, and third, added, for three Years, *&c.*

Example.

Example.

What's the present Worth of an Annuity of 50 *l.* to continue four Years, Rebate at 5 *l. per Cent. per Annum?*

50,		47,61904
47,61904	Divided by 1,05	45,35147
45,35147	the Rate, gives	43,19187
43,19187		41,13512

The Total of which is 177,29750 the present Worth requir'd.

And after this Manner is made Table the fourth, which shews the present Worth of 1 *l.* Annuity, to continue any Number of Years under 33, Rebate at 5 and 6 *l. per Cent. per Annum*, Compound Interest. Which Table, as the others, will give the present Worth of any Sum whatsoever, by only multiplying the Value of 1 *l.* by the Sum propos'd. Thus suppose the foregoing

Example.

3,54595 the present Worth of 1 *l.* for 4 Years, multiply'd by 50 the Annuity propos'd,

gives 177,29750 as before.

The fourth Table may be also form'd from the second, thus;

The first Year is the same in both; the first and second Years of the second, added together, make the second of the fourth; the second Year of the fourth, added to the third Year of the second, makes the third of the fourth Table, &c. See the

Example

Example *at 6 l. per Cent.*

,94339*	The first Year of both Tables.
,88999	The second Year of the second Table
1,83339	The second Year of the fourth.
,83961	The third Year of the second.
2,67300	The third Year of the fourth, &c.

* *Note* 1 must be added to the right Hand Figure for the Places omitted.

Decimal Tables

shewing

TABLE 1st. The Amount of one Pound for any Number of Years under 33, at 5 Rates of 5 & 6 pCt. p.an: Com: Inter:

TABLE 2d. The Amount of 1 £ Annuity for any number of years under 33, at 5 Rates of 5 & 6 pCt. p.an: Com: Interest.

5 Rates	6	Years	5 Rate	6
1,05000	1,06000	1	1,00000	1,00000
1,10250	1,12360	2	2,05000	2,06000
1,15762	1,19101	3	3,15250	3,18360
1,21550	1,26247	4	4,31012	4,37461
1,27628	1,33822	5	5,52563	5,63709
1,34009	1,41852	6	6,80191	6,97532
1,40710	1,50363	7	8,14200	8,39383
1,47745	1,59384	8	9,54910	9,89746
1,55132	1,68948	9	11,02656	11,49131
1,62889	1,79084	10	12,57789	13,18079
1,71034	1,89829	11	14,20678	14,97164
1,79585	2,01219	12	15,91712	16,86994
1,88565	2,13292	13	17,71298	18,88213
1,97993	2,26090	14	19,59863	21,01506
2,07892	2,39655	15	21,57856	23,27597
2,18287	2,54035	16	23,65749	25,67252
2,29201	2,69277	17	25,84036	28,21288
2,40662	2,85434	18	28,13238	30,90565
2,52695	3,02559	19	30,53900	33,75999
2,65329	3,20713	20	33,06595	36,78559
2,78596	3,39956	21	35,71925	39,99272
2,92526	3,60353	22	38,50521	43,39229
3,07152	3,81975	23	41,43047	46,99583
3,22510	4,04893	24	44,50199	50,81557
3,38635	4,29187	25	47,72709	54,86451
3,55567	4,54938	26	51,11345	59,15638
3,73345	4,82234	27	54,66912	63,70576
3,92013	5,11168	28	58,40258	68,52811
4,11613	5,41838	29	62,32271	73,63979
4,32194	5,74349	30	66,43884	79,05818
4,53804	6,08810	31	70,76079	84,80167
4,76494	6,45338	32	75,29883	90,88977

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Decimal Tables

shewing

TABLE 3d. The present Worth of 1£ due at any number of years to come under 33 Rebate at 5 & 6 Pct. pan: Com: Interest

TABLE 4th. The present Worth of 1£ Annuity to continue any number of Years under 33 Rebate at 5 & 6 Pct. pan: Com: Interest

Rates 5	Rates 6	years	Rates 5	Rates 6
,952381	,943396	1	0.95238	0.94339
,907030	,889996	2	1.85941	1.83339
,863838	,839619	3	2.72324	2.67301
,822702	,792093	4	3.54595	3.46510
,783526	,747258	5	4.32947	4.21236
,746215	,704960	6	5.07569	4.91732
,710682	,665057	7	5.78637	5.58238
,676839	,627412	8	6.46321	6.20979
,644609	,591898	9	7.10782	6.80169
,613913	,558394	10	7.72173	7.36008
,584679	,526787	11	8.30641	7.88687
,556837	,496969	12	8.86325	8.38384
,530321	,468839	13	9.39357	8.85268
,505068	,442301	14	9.89864	9.29498
,481017	,417265	15	10.37965	9.71225
,458111	,393647	16	10.83777	10.10589
,436296	,371364	17	11.27406	10.47726
,415520	,350343	18	11.68958	10.82760
,395734	,330513	19	12.08532	11.15811
,376889	,311804	20	12.46221	11.46992
,358942	,294155	21	12.82115	11.76407
,341849	,277505	22	13.16300	12.04158
,325571	,261797	23	13.48857	12.30338
,310067	,246978	24	13.79864	12.55035
,295302	,232998	25	14.09394	12.78335
,281240	,219810	26	14.37518	13.00316
,267848	,207368	27	14.64303	13.21053
,255093	,195630	28	14.89812	13.40616
,242946	,184556	29	15.14107	13.59072
,231377	,174110	30	15.37245	13.76483
,220359	,164254	31	15.59281	13.92908
,209865	,154956	32	15.80267	14.08404

Webster Scrip.t

Bickham sculp.t

More Examples *for the Exercise of the foregoing Rules and Tables.*

Ex. 1*ſt.* What will 1000 *l.* increaſe to, forborn 22 Years, at 5 *per Cent. per Annum* compound Intereſt?

Anſwer, 2925 *l.* 5 *s.* 3 *d* $\frac{1}{4}$.

Ex. 2*d.* What would an Annuity of 520 *l.* forborn 17 Years, at 6 *per Cent.* compound Intereſt, amount to?

Anſwer, 14670 *l.* 13 *s.* 11 *d* $\frac{1}{4}$.

Ex. 3*d.* What preſent Money would diſcharge a Debt of 7500 *l.* to be paid at the End of 20 Years, Rebate being made at 5 *l. per Cent. per Annum*?

Anſwer, 4604 *l.* 6 *s.* 11 *d.* $\frac{1}{4}$.

Ex. 4*th.* What is a yearly Rent of 65 *l.* to continue 30 Years, worth in ready Money, Rebate being made at 6 *per Cent. per Annum* compound Intereſt?

Anſwer, 894 *l.* 14 *s.* 3 *d* $\frac{1}{2}$.

Ex. 5*th.* What is the preſent Worth of a Reverſion of a Leaſe of 500 *l. per Annum,* to continue 20 Years, but not to commence 'till after the End of five Years, allowing the Purchaſer 6 *per Cent.* compound Intereſt?

Note, To work Queſtions of this Nature, there muſt be two diſtinct Operations, *viz.*

1*ſt.* The preſent Worth of the propos'd Annuity, for the given Time of its Continuance, muſt be found as if it were immediately to commence. Then,

2*d.* See what Principal, forborn at the given Intereſt, would, in the Time of the Reverſion, amount to the aforeſaid preſent Worth, and that Principal will be the preſent Worth of ſuch Annuity in Reverſion.

Thus by Table the 4th, the preſent Worth of 1 *l.* *per Annum*, to continue 20 Years, at 6 *l. per Cent.* is found to be 11,46992

which multiply'd by the propos'd Annuity, 500

gives 5734,96000

Then in the firſt Table, againſt 5 Years, the Time of the Reverſion, under the ſame Rate of Intereſt, is found 1,41852 the Amount of 1 *l.* in the ſaid Time; therefore

If 1,41852 ariſe from 1 *l.* from what Principal does 573496 ariſe?

Anſwer, 4042,917, or 4042 *l.* 18 *s.* 4 *d.* $\frac{1}{4}$.

Of purchaſing Freehold Eſtates.

TO find the preſent Worth of any annual Rent to continue for ever, commonly call'd Fee-Simple.

Rule.

Divide the propos'd Rent by the Intereſt of 1 *l.* for one Year, (which at 5 *l. per Cent.* is ,05, or at 6 *per Cent.* ,06, as before ſhewn) and the Quotient is the preſent Value of the Eſtate.

Example.

What is an Eſtate of 200 *l. per Annum*, to continue for ever, worth in ready Money, allowing the Purchaſer 5 *l. per Cent. per Annum* compound Intereſt?

,05)200,00(

Answer, 4000 *l.*

Or it may be done by multiplying the Fee-Simple of 1 *l.* by the yearly Rent propos'd.

The Fee-Simple of 1 *l. per Ann.* compound Interest, at

1 *per Cent.*	2 *per Cent.*	3 *per Cent.*	4 *per Cent.*	5 *per Cent.*
100,00000	50,00000	33,33333	25,00000	20,00000

6 *per Cent.*	7 *per Cent.*	8 *per Cent.*	9 *per Cent.*	10 *per Cent.*
16,66667*	14,28571	12,50000	11,11111	10,00000

* *Note*, In contracting a Line of Decimals from many to fewer Places, 1 is added to the laſt Figure retain'd, if the next omitted Figure exceedeth 5; which Rule hath been all along obſerv'd in the Tables, &c.

The foregoing Queſtion work'd by the laſt Rule.

	l.
The Fee-Simple of 1 *l. per Ann.* at 5 *l. per Cent.* is	20
Which multiply'd by the yearly Rent,	200
gives as before,	4000 *l.*

I will now only add another Example or two, for the Reader's Exerciſe, and conclude this Rule.

1. *A* has the Poſſeſſion of an Eſtate of 130 *l. per Annum*, to continue 20 Years; *B* has the Reverſion of the ſame, from that Time for ever. What muſt *A* give *B*, if he would purchaſe his Reverſion? And what muſt *B* give *A*, if he would buy his Poſſeſſion, accounting 6 *per Cent.* compound Intereſt in each Caſe?

		l.	*s.*	*d.*
Answer,	*A*'s Poſſeſſion is worth	1491	1	$9\frac{1}{4}$
	B's Reverſion is worth	675	11	8

2. *A* agrees with *B* for an Annuity of 600*l.* *per Annum*, to continue 25 Years, to give him the present Worth of it, at 6*l.* *per Cent. per Annum*; but not having Money enough by him, offers to make over to him a Freehold-Estate of 12*l.* *per Annum* at the same Interest, what Money besides will pay his Purchase?

Answer, 7470*l.* 0*s.* 3*d.* ½.

CHAP.

CHAP. VI.

FELLOWSHIP.

WIthout taking any Notice of the common Way of working this Rule, obſerve this much more compendious Method.

Rule.

Divide the whole Gain, or Loſs, by the whole Stock, and multiply the Quotient by each Man's particular Stock, the ſeveral Products are the reſpective Gains of each.

Note, It is neceſſary to place ſo many Cyphers on the right Hand of your Dividend, as will bring out ſix or ſeven Places of Decimals in the Quotient.

Example.

Suppoſe *A*, *B*, and *C* trading together, *A* puts in 500*l.* *B* 700*l.* and *C* 1200*l.* their whole Gain is 836*l.* what Share of it belongs to each?

2. | | l. |
|---|---|
| A | 500 |
| B | 700 |
| C | 1200 |

Total Stock 2400)836,000000(,348333

11600

20000

8000

8000

8000

800

	,348333 500	,348333 700	,348333 1200
A's Share	174,166500	B's 243,833100	C's 417,999600
B's Share	243,833100		
C's Share	417,999600		

Total Gain 835,999200, or 836l. as near as can be.

See another Example *with Time.*

A puts into Company 525 *l.* 10 *s.* for six Months, *B* 382 *l.* 15 *s.* for eight Months, and *C* 1000 *l.* for four Months; they gain'd in all 1216 *l.* 12 *s.* how much is that for each?

	525,5	382,75	1000
	6	8	4
A's Stock	3153,0	3062,00	4000
B's Stock	3062		
C's Stock	4000		

10215)1286,600000(,125952

	,125952	,125952	,125952
	3153	3062	4000
A's Gain	397,126656	385,665024	503,808000
B's	385,665024		
C's	503,808000		
Total	1286,599680	or 1286l. 12s. as near as can be.	

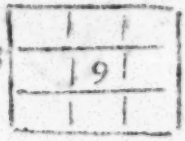
CHAP.

CHAP. VII.

Extraction of the ROOTS.

Extraction of the SQUARE ROOT

IS finding what Number, multiply'd by it ſelf, will produce the Number given, which is always ſuppos'd a Square Number, that is, one great Square compos'd of many ſmall ones, as in the following Figure, containing nine ſmall Squares, the Side or Root of which, is 3.



Square Numbers are either ſingle or compound.

A ſingle Square Number is always leſs than 100, being produc'd by the Multiplication of ſome one ſingle Figure by itſelf, as 16 from 4, &c. So that the Root of any

any ſingle Square may be found in the annex'd Table, always taking the Root of the next leſs Square, for any Number not there inſerted, as for 26 take 5, or 3 for 10, &c.

Squares	1	4	9	16	25	36	49	64	81
Roots	1	2	3	4	5	6	7	8	9

A compound Square Number being compos'd by the Multiplication of two or more Figures by themſelves, always exceeds 100; as 144, which is 12 times 12; or 195, which is 15 times 15, &c.

Therefore, to find the Root of any compound Square Number, as ſuppoſe 2704,

1ſt. You muſt diſtinguiſh it into ſingle Squares, by placing Dots over every other Figure, beginning at the right Hand, thus,

2704.

And ſo many Dots as happen, ſo many Places will the Root conſiſt of, which in this Example are two.

2dly. Drawing a crooked Line on the right Hand of your Number, as in Diviſion, find the Root of your firſt ſingle Square, and place it in the Quotient. See the Work:

2704(5

3dly. Placing the Square of the Root found, under the firſt ſingle Square, ſubſtract, and ſet down the Remainder; bringing down to it the next ſingle Square, call the Line a *Reſolvend.*

2704(5
25
---
204 *Reſolvend.* 4thly.

4thly. Drawing another crooked Line on the left Hand of the ſaid Reſolvend, place beyond it the Double of the Quotient, in Form of a Diviſor.

```
  .  .
2704(5
25
---
10)·204
```

5thly. Dividing the Reſolvend, all but the Unit's Place, by the ſaid Diviſor, (which, in this Example, is the 10's in 20) ſet down the Number of Times it goes, (*viz.* 2) both in the Quotient, and on the right Hand of the Diviſor:

```
  .  .
2704(52
25
---
102) 204 R.
```

6thly. Multiplying the whole Diviſor by the Figure laſt plac'd in the Quotient, ſet down the Product under, and ſubſtract it from the Reſolvend. See the Work.

```
  .  .
2704(52
25
---
102)204
204
---
·0
```

Note.

If the Diviſor, multiply'd by the Quotient-Figure, gives a Product greater than the Reſolvend, 'tis falſe, and muſt be rectify'd by a ſmaller Quotient-Figure.

Note alſo, As many ſingle Squares as are in the Number propos'd, ſo many times muſt the Work of the three laſt Rules be repeated; every Square being to be brought down, as directed in the third Rule.

Example.

What's the Root of 582169(763 *Anſwer.*
49

146)· 921 *Reſolv.*
876

1523)· 4569 *Reſolvend.*
4569

0

In this Example, to 45 the ſecond Remainder, 69 the next Square, being brought down, make 4569 a new Reſolvend; and 76, the Quotient-Figures, being doubled for a new Diviſor, make 152, which going three times in the Reſolvend, 3 is plac'd both in the Quotient, and on the right Hand of the Diviſor, which being then multiply'd by 3, gives 4569, equal to the Reſolvend; ſo that nothing remains.

The Proof of this Extraction, is only multiplying the Root found by it ſelf, which, if right, will produce the Square Number given. Note, if any thing remains, it muſt be taken in.

To find the Fractional Part of the Root, add to the Number given, a competent Number of Pairs of Cyphers, and proceed by the foregoing Rules: As ſuppoſe 75896 were given for an

Example.

Example.

```
. . . . . .
75856,000000(275,492
4
---
47)358
   329
---
545)2956
    2725
---
5504)27100
     22016
---
55089)508400
      495801
---
550982)1259900
       1101964
---
        157936
```

Note, As many Pairs of Cyphers as are added, so many Places of Decimal Parts will there be in the Root.

To extract the Square Root of a Fraction.

Find the Root of the Numerator for a Numerator, and let the Root of the Denominator be its Denominator; thus the Square-Root of $\frac{16}{25}$ is $\frac{4}{5}$, and of $\frac{4}{9}$ is $\frac{2}{3}$, &c.

The Root of a mix'd Number is also found after the same Manner, being first reduc'd into an improper Fraction; thus $6\frac{1}{4}$ reduc'd, makes $\frac{25}{4}$, the Root of which is $\frac{5}{2}$, or $2\frac{1}{2}$.

But if either a proper Fraction, or a mix'd Number be incommensurable to its Root, to extract it, reduce the Fraction to a Decimal of an even Number of Pla-

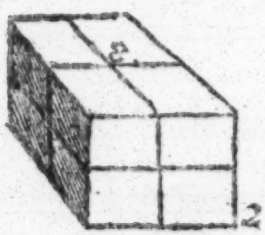
ces, and extract the Root as if it were a whole Number, thus $\frac{7}{8}$, reduc'd to a Decimal, will be ,8750, the Square Root of which is ,935, &c. or had it been $4\frac{7}{8}$, which, reduc'd, is 4,8750, the Root would be 2,935, &c.

Extraction of the CUBE ROOT

IS finding what Number, multiply'd twice into it ſelf, will produce the Number given; thus the Cube Root of 64 is 4, 4 times 4 being 16, and 4 times 16 making 64.

What a Cube is, may be ſomething explain'd by the following Figure, wherein 8 Dice are ſo diſpos'd, that there are 2 every Way, that is, 2 in Length, 2 in Breadth, and 2 in Heighth; ſo that 8 is the Cube, and 2 the Root.

See the Figure.



Cube-Numbers are either ſingle or compound.

A ſingle Cube Number is always leſs than 1000, being produc'd by the Multiplication of one ſingle Figure, firſt by itſelf, and then by its Product, as 125 from 5, &c. ſo that the Root of any ſingle Cube may be found in the annex'd Table; always remembering to take the Root of the next leſs Cube for any Number not there inſerted, as for 513 take 8, or 6 for 220, &c.

Cubes	1	8	27	64	125	216	343	512	
Squares	1	4	9	16	25	36	49	64	
Roots	1	2	3	4	5	6	7	8	

A Compound-Cube Number being compos'd by Multiplication of 2 or more Figures, first by themselves, and then by their Product, always ends in 000, as 1728 from 12, or 15625 from 25, &c.

Therefore to find the Root of any Compound Cube Number, as suppose 15625.

1*st*. You must distinguish it into single Cubes, by placing Dots over every third Figure, beginning at the right Hand, thus

15625

and so many Dots as happen, so many Places will the Root consist of, which, in this Example, are two.

2*dly*. Drawing a crooked Line on the right Hand of your Number, as in Division, set down as a Quotient the Root of your first single Cube, which, in this Example, is 2.

3*dly*. Placing 8, the Cube of 2 the Root found, under 15 the first single Cube, subtract, and to the remainder 7 bring down 625 the next single Cube, and it will make 7625, which call a Resolvend. Thus in Work:

15625(2
8

7625 *Resolvend.*

4*thly*. Draw a Line under the Reſolvend, and tripling the Square of the Root 2, ſet the ſaid triple Square (*viz.* 12) under the Reſolvend; ſo that Units in the ſaid triple Square may ſtand under the Place of Hundreds in the Reſolvend.

5*thly*. Subſcribe alſo the Triple of the Root 2 (*viz.* 6) ſo that Units, in this, may ſtand under the Place of Tens in the Reſolvend.

6*thly*. The triple Square of the Root, and triple Root, being plac'd as directed, draw a Line under them, and add them together in the Order they are plac'd; the Sum 126 is a Diviſor.

7*thly*. Accompting all the Reſolvend (except the Place of Units, (*viz.* 762) a Dividend, ſeek how often the Diviſor (126) is contain'd in it, and place the Number of Times (which is here 5) in the Quotient.

8*thly*. Draw a Line under the Diviſor, and multiplying the triple Square (12) by 5, the Figure laſt plac'd in the Quotient, ſet the Product (60) ſo under the ſaid triple Square, that Units may ſtand under Units, and Tens under Tens.

9*thly*. Squaring the Figure (5) laſt plac'd in the Quotient, multiply its Square (*viz.* 25) by the triple Root (6), and place the Product (150) ſo that Units, in this, may ſtand under Units in the ſaid triple Number.

10*thly*. Subſcribe the Cube of (5) the Figure laſt plac'd in the Quotient, which will be 125, ſo that Tens in this may ſtand under Units in the former Product.

11*thly*. Then drawing a Line, add the three Numbers laſt plac'd together, and ſubſtracting the Sum (7625,

which is call'd the Ablatitium) from the Reſolvend, & down the Remainder (if any) in order underneath, a in common Subſtraction. See the Work:

15625(25
8

7625 Reſolvend.

12
6
---
126 Diviſor.

60
150
125

7625 Ablatitium.
---
0 0 0

Note, If the given Number hath more Place, th next ſingle Cube muſt be brought down to the laſt R mainder, for a new Reſolvend, and the Work of th 4th, 5th, 6th, 7th, 8th, 9th, 10th, and 11th Ru muſt be again repeated; and ſo as often as you fin new Reſolvend.

Note alſo, If the Ablatitium is greater than the R ſolvend, the Work is falſe, and muſt be rectify'd b placing a leſſer Figure in the Quotient.

The Proof of this Extraction, is by multiplying the Root found, first by it self, and that Product again by the Root, adding the Remainder, if there be any, to the last Product; thus,

25 the Root,
multiply'd by 25

125
50

gives 625
again by 25 the Root,

3125
1250

gives 15625

To find the Fractional Part of the Root, add to the Number given, so many Ternaries of Cyphers, as you would have Places of Decimal Parts in the Root, and proceed by the foregoing Rules. As suppose 865635 were given for an

Example.

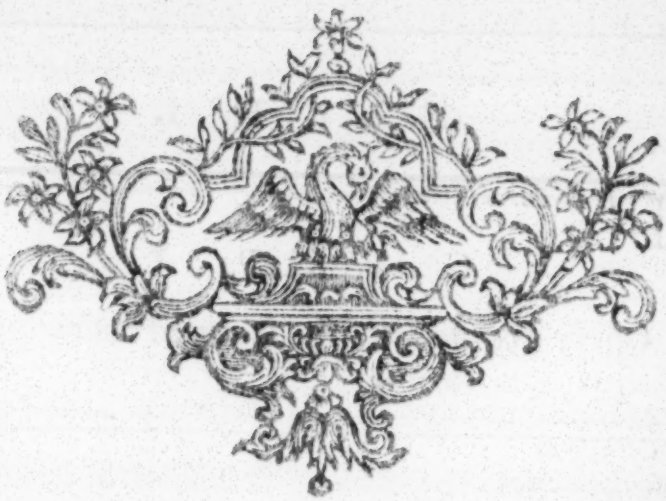
865635,000000(94,99
729
136635 Reſolvend.
243
27
2457 Diviſor.
972
432
64
101584 Ablatitium.
35051000 Reſolvend.
26508
282
265362 Diviſor.
238572
22842
729
24086349 Ablatitium.
1096465000 Reſolvend.
2701803
2847
270208 77 Diviſor.
24316227
230607
729
2433929499 Ablatitium.
8530721501

In this Example, there being two Ternaries of Cy-
phers, the Root muſt have two Decimal Places.

The

The Cube-Root of a vulgar Fraction is found after the ſame Manner as the Square Root, *viz.* by finding the Root of the Numerator given, for a new Numerator, and the Root of the Denominator given, for a new Denominator.

Alſo if the Vulgar Fraction be incommenſurable, it muſt be reduc'd to a Decimal, as directed in the Square Root, and then extracted.



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